

S103

discovering
science

Study Guide for Block 1

This first block of *Discovering Science* is designed to provide an accessible introduction to studying science with the Open University. It weaves together a variety of scientific ideas, all related to 'water for life', and starts to develop the range of skills that are needed to study science. It is intended to be studied in *about* 27 hours spread over about two weeks. However, the time that you will require to complete your study of this block will depend on your familiarity with and experience of science. If you have had little experience of studying science then it will probably help you if you begin to study the block early to ensure a reasonably gentle introduction. As you progress through the course you will find that the level of study intensifies. However, your study skills and familiarity with the content of the course will improve to keep pace.

The study plan on the reverse side of this Guide shows how the different parts of Block 1 relate to each other. The main left-hand column lists the seven sections of the book. To the right of this we show our estimates of the amount of time it *might* take to study each section, *including* all of the activities associated with that section. On the far left of the plan you can see how we suggest that you split the study of the block over a two-week period. You may wish to modify this if you have planned to take longer studying Block 1 than the nominal two-week period. The right-hand side shows where the non-text components fit into the block, together with estimates of the times required to study them. As you can see, there are DVD-video activities associated with Sections 2, 3 and 6, and there is practical work associated with Section 3. Each study week will involve you in working with a number of different components. For example, week 1 includes working through the first two sections of the book, *Water for life*, using the Study File for various activities, and viewing a DVD-video. There is then some practical work to carry out; for this you will need approximately 500 grams (about 1 pound) of potatoes, kitchen scales, and the use of a microwave oven

or a conventional oven (see the notes in the Study File for Activity 3.2 for more details).

The time estimates should help you to plan the time you need to set aside. Of course, some sections of this block may take you longer than our estimated times, and some may take less time. So be prepared to modify our study plan when you see the rate at which you are progressing, or to modify it to fit in with the amount of time you can set aside to study.

There is a short 'practice' assignment associated with Block 1, which you should do when you have completed the block and should send to your tutor for comment by the cut-off date. This assignment is not awarded a mark and thus does not count towards your final mark for the course, but you will receive important feedback from your tutor that you will find valuable when doing later assignments. It will also enable your tutor to anticipate which areas of study you may need help with during your study of the next few blocks. The assignment (TMA 01) is in *Assessment Booklet 1*, and you will need to set aside about two hours to answer the questions.

There are a number of further tasks for you to tackle after completing your study of Block 1 and before you begin Block 2. Details of these are included in the section of the Study File entitled 'What to do now?', and you will be reminded of these at the end of the book.

Note that this card is designed to be used as a 'bookmark' *during* your study of Block 1. You can then file it with your Block 1 Study File material when you move on to Block 2.

After looking again at the plan overleaf, start your study of Block 1 by reading Section 1 of the book.

1 Water for life

All study times are in hours*

Week	Sections of Block 1	Total study time	DVD-video and practical activities
1	1 Introduction	$\frac{1}{4}$	
	2 Life in the desert?	5	 $\frac{1}{2}$
	3 Water in living organisms	$5\frac{3}{4}$	 $1\frac{1}{2}$  $\frac{1}{2}$
	4 Properties of water	6	
2	5 Communicating science	2	
	6 Water, society and the environment	$6\frac{1}{2}$	 $\frac{1}{2}$
	7 Afterword	$1\frac{1}{2}$	

*Times given here are to the nearest quarter hour. More precise times are given in the Study File notes. Note that the times for DVD-video and practical work are included in the total time for the section in which they are studied.



DVD-video



practical work

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Study File for Block 1

Contents

Notes on activities	1
What to do now?	24
Comments on activities	25
Objectives for Block 1	37
Using <i>The Sciences Good Study Guide</i>	39
Glossary for Block 1	42

Notes on activities

Read this before anything else!

After noting the advice in the *Study Guide for Block 1*, you are ready to read the notes for each activity, which explain what you are required to do. They may also provide a table, grid or diagram to complete, or give guidance on how to tackle an activity. *It is, therefore, essential that you read through the notes before attempting the activity.*

In order to help you organize your time, we give advice regarding the length of time required to work on an activity. The advice is of two types. For some activities we give an estimate of the time required to complete the activity (although you may take more or less than this depending on your previous experience). For other activities we specify a maximum time we think you should spend on the activity. Spending the specified time will allow you to get to grips with what is required of you but not necessarily to perfect your answer to the activity. No estimate of time is given for activities which should take 10 minutes or less.

After completing an activity you should study the relevant comments in the 'Comments on activities' section of the Study File (p. 25). These may contain a 'sample' answer, further hints, extra advice or more explanation. You can also use the comments to learn how to tackle a similar problem if you get stuck.

Activity 1.1 Preparing for study

(a) Where will you study? You may manage to do some studying in between domestic tasks, while commuting or during free time at work, but it is likely that a major part of your studying will be done at home. As you will be spending about 15 hours a week studying when the course starts, it is worth sorting out now the best place to do this. It is an advantage to have a place that you can use whenever you want to study, where you can read and write comfortably, where you won't be distracted by other people you live with and where you won't interfere with their activities. You may want to discuss possibilities with them. You will also need a place for your computer, preferably a place where you can keep it set up ready to use at any time.

(b) Where will you keep your Open University materials? In addition to the first mailing of course materials, you will already have received material from other parts of the Open University. Unless you sort out this material, you will soon find that you have a large pile of paper, and you are unable to find the piece you want. The amount of material you receive will increase rapidly, and some sort of filing system is necessary. Think about how you will sort the materials you have received so far, classifying them for example 'for reference' or 'general information about OU' or 'information from Regional Centre'. You may want to file them in labelled box files or ring binders. Ideally you need somewhere to store all your books and files, calculator and writing materials (including pens and pencils, an eraser, a ruler and some A4-size writing paper) so that they are readily accessible. You may find it helpful to discuss, with the people you live with, where you are going to keep your OU materials.

After thinking about these practical arrangements, look at the comments on this activity, which start on p. 25 of the Study File.

Activity 2.1 Monitoring your study

The study plan on the bookmark shows that Section 2 should take you about five hours, of which about 30 minutes involve working with a DVD-video. The best time to do this activity is after completing your study of Section 2. Use the grid below to keep a log of when you study Section 2, and for roughly how long you study at each session.

	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
morning							
afternoon							
evening							

(Now read up to the end of Section 2.6. There are no comments to read until you have completed this section.)

After completing your study of Section 2.6

Look at your log of study times in the grid above.

(a) When did you study — which days and which times of the day? Did you find that certain days and/or times suited you better than others? How did your study time compare with our estimated time of about $4\frac{1}{2}$ hours to study the text — longer, shorter or about the same?

(b) For how long did you study at a time? What determined the length of each study period — was it the amount of time available, your ability to concentrate, or the nature of the particular task?

Now look at the comments on this activity.

Activity 2.2 Understanding text: the scientific method

(a) First, you might like to try writing down what you understand by the term 'scientific method' *without* looking back at the text. This will give you an indication of how much you have 'absorbed' from the text and will also mean that you are more likely to explain the concept *in your own words*. This is always important because until you describe something to yourself in words that you are comfortable using you will not feel you fully understand it.

However, if you find this too difficult — and this is perfectly reasonable at this stage in the course — go back and read the relevant part(s) of the text, make a few notes and then *close the book* and write your response from your notes. This avoids the temptation to copy phrases from the text and is more likely to ensure you use your own words.

(b) Now look back at the section headed 'People don't live in deserts', and in particular to the part following Box 2.1. Match the steps in this account to the steps of the scientific method.

Activity 2.3 Finding time and motivation for study

(The estimated time for this activity is 25 minutes.)



You will be making frequent use of DVD-video sequences. All of them are listed, like a contents page, in the Multimedia Guide on each DVD, and you will be able to select what you need for each block of the course. Video activities require more than just watching the screen and listening to the words; they have much in common with studying text — you need to concentrate on what is actually being said and try to follow the argument. You will find that it usually helps to make notes while you watch. Of course, you can stop the clip at any point and look at part of it again, in the same way that you would reread a demanding piece of text.

In this particular DVD-video, four Level 1 students and their tutor are meeting at a local centre. We suggest that you view this through once, and then, while viewing it a second time, you stop at appropriate places and note down useful tips that the students provide about:

- how they find time for study;
- when they study;
- for how long they study at a session;
- how they find motivation for study.

The DVD-video sequence 'Finding time and motivation for study' can be found on DVD 1 in the Block 1 folder. You will find that the DVD-video sequences have numbers in the top right-hand corner of the screen. These timing numbers are to help you locate each sequence and the appropriate numbers will be given in brackets in each video activity. This first sequence starts after the introduction at timing number 6 and continues until timing number 25. You should view this now. Remember to look at the comments on this activity afterwards.

Activity 3.1 Planning your study

(The estimated time for this activity is 20 minutes spread over several sessions.)

To help you plan when you will do the practical work in Section 3, you should read carefully the first three sections of the Study File notes for Activity 3.2 (Aims, Introduction, and Planning the experiment), and briefly survey the remaining sections to see what is required. As you will see, there is more than one way of doing the experiment and the way you decide to do it will influence your plan of work. You will find it easier to do the practical work after completing your study of Section 3.1 (which requires an estimated study time of an hour and a half). The study plan on the bookmark shows that there is also a DVD-video activity to do (Activity 3.3). It would be best to do this activity immediately after completing the experiment, or at the beginning of the subsequent study session, as it relates to the practical work. So read the first three sections of the Study File notes for Activity 3.2 now, and note down on the grid overleaf when you plan to do the practical work.

You also need to spend some time preparing to do the experiment: in the same way as when you make a cake or a set of shelves, you need to check that you have all the materials and equipment, and assemble them together.

Finally, you need to bear in mind any decisions you made as a result of Activities 2.1 and 2.3. Do you need to allow more time for Section 3 than the estimate on the study plan on the bookmark? Are you going to try a different study pattern? For example, you may decide to work for some short periods of 30 minutes in addition to longer stretches of, say, 2 hours.

Each time period on the grid is divided into two halves. Use the upper half to record when you *plan* to do the practical work and study the DVD-video. Use the lower half for keeping a log of the approximate amounts of time you *actually* spend studying Section 3, including assembling the materials, doing the practical work and watching the DVD-video. Comparison of the two halves will reveal the extent to which you need to modify *our* estimates to match your own study needs.

	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
morning planned							
morning actual		1:30 - 5					
afternoon planned		1:30 - 5 VIDEO Experiment					
afternoon actual		1:30 - 5 VIDEO EXPERIMENT	7:45 - 9:15				
evening planned							
evening actual							

(There are no comments to read for this activity before you have completed Section 3.4.)

After completing your study of Section 3.4

Look at the log above to review your work plan and calculate the total amount of time you spent on Section 3, including the practical work.

- Were you able to carry out the practical and DVD-video activities at the times you had planned? If not why did your plans have to change? Make a note of the changes you would make to the way that you plan or prepare for the practical work and DVD-video activities.
- If you tried a different study pattern this week from the previous week, perhaps by varying the time of day and/or the length of time that you studied at a stretch, make a note of what was successful for you.
- How does the total time spent on Section 3 compare with our estimated time of 5½ hours?

Activity 3.2 How much water is there in potatoes?

(The estimated time for this activity is an hour and a half in total, including 10 minutes to read through the Instructions section before starting the practical work.)



Aims

- 1 To determine the percentage of water in potatoes.
- 2 To develop skills associated with experimental design, planning and carrying out measurements, recording and analysing results, and thinking critically about experimental work.

Introduction

You will determine the percentage of water in potatoes by weighing some potatoes using kitchen scales, drying them in an oven or airing cupboard to remove the water, and then reweighing the potatoes. You will check that all of the water has been removed by taking a series of measurements of mass, until the mass no longer decreases.

The experiment should take about an hour and a half of your active time in total. You will need an initial 10 minutes to read through the instructions, and you will need about 20 minutes for working out the results and thinking critically about the experiment. The experiment itself will take about an hour, but the spread of that time will depend on the method you use to dry the potatoes. Further details of the time needed for the different methods is given in the 'planning' section below.

Planning the experiment

You need to think about a variety of factors when planning the experiment, and the following questions and answers guide you through them.

Where should I do the experiment?

Given that the experiment involves using an oven and kitchen scales, the answer to this is almost certainly in the kitchen.

How should I dry out the potatoes?

You can do this by using a microwave oven, or a conventional electric or gas oven, or an airing cupboard. The *microwave oven* method is the quickest; the preparation of the potatoes and the measurements should take about an hour. If you use a *conventional electric or gas oven*, the experiment will take much longer from start to finish, perhaps up to 12 hours, because it will take longer to remove the water from the potatoes. However, after spending 20 minutes preparing the potatoes, the actual time you need to spend making measurements of the mass of the potatoes will only be 30–40 minutes, but split into periods of a few minutes every hour or two. If you don't have a single long stretch of time to do this, you can heat the potatoes for a few hours one evening, leave them to cool in the oven overnight, and heat them again the following day until the mass is constant. If you opt to use the *airing cupboard* method, then the experiment will take even longer, perhaps a couple of days. However, as with a conventional oven, you will only need to spend periods of a few minutes making the mass measurements, though in this case you would make the measurements about every four hours, bearing in mind that the time interval will be longer than this over night.

Which oven setting should I use?

With a *microwave oven*, you can use the maximum power setting. You can start with bursts of 4 minutes, weighing the potatoes between bursts, but as the potatoes dry out you will need to use shorter heating periods to minimize the risk of them burning. With a *conventional oven*, you will need to keep the temperature fairly low, otherwise the potatoes will burn before they dry out; 100 °C, 225 °F, gas mark 1, is recommended, or the lowest setting possible if your oven doesn't have a setting this low.

Which scales should I use?

The experiment can be done with any type of kitchen scales that will measure up to at least 1 kilogram (or 2 pounds). It doesn't matter whether the scales weigh in grams or ounces, though the former is preferable for a scientific experiment. The more sensitive

Equipment

NON KIT ITEMS

Oven (microwave or conventional) or airing cupboard
Kitchen scales
Large flat-bottomed ovenproof plate or pan
Aluminium kitchen foil (optional)
Sharp knife
Chopping board
Potatoes — about 500 grams (or 1 pound)
Oven glove
Heatproof mat or pad to protect scales
Further guidance about the equipment is given in the section headed 'Instructions: practical procedure'.

the scales are to a small change of mass, the better. Ideally you should be able to distinguish a change of about 20 grams (or half an ounce), and this is possible with most kitchen scales. If you don't have suitable kitchen scales, you may be able to borrow them from a neighbour. If you are unfamiliar with using the scales, it would be worth weighing a few objects before you start the experiment to give yourself practice and to see how precisely you can do it.

How many potatoes do I need to use?

About 500 grams (or 1 pound if you are using non-metric scales) should be adequate. If you use much less than this, you will find it difficult to measure the small masses accurately once the potatoes have dried out. If you use more, it will take longer for the water to escape.

What can I do to the potatoes to help the water to escape?

If you put potatoes in the oven to bake in their jackets, they will retain water for a long time. To help the water to escape, you need to cut the potatoes into very thin slices, and to spread these out in the oven. You will also need to turn and separate the slices periodically. However, you should not peel the potatoes and throw the peel away since you need to measure the percentage of water in the whole potatoes.

What do I put the potatoes on while drying them?

If you use a *microwave oven*, you will need to put the potatoes on a large plate or flat dish that is microwave-safe (not metal). If using a *conventional oven*, then you can use an ovenproof plate or flat metal pan. In this case, you could cover the plate or pan with aluminium foil that has been lightly crumpled and then spread out, so that when you place the potato slices on this rough surface some of the water will be able to escape from the bottom of the potatoes. If you use the *airing cupboard* method, you can use any type of plate or dish, or you could use a (cake) cooling rack. Whatever type of plate, dish or pan you are using, it will need to fit on the scales with the potatoes spread out on it, and it should be as light as possible (certainly below the maximum range of the scales with 500 grams of potato on it). Though scales should not be damaged by temperatures of 100 °C, it would be advisable to protect them with a heatproof mat or pad (or a newspaper or magazine) in case your oven temperature is higher than expected. This protective cover should be left on the scales for all the weighings that you do for this activity.

How do I know when the water has all been removed?

The water will be driven out gradually, so the mass of the potatoes will decrease steadily with time. You can assume that the water has all been removed when successive measurements of the mass of the potatoes are the same.

Instructions: practical procedure

Read the whole of this section before starting the experiment.

It is always a good idea to read through any instructions for an experiment before you start, so you have a clear idea of what you will have to do. Then as you carry out the experiment, note in the margin alongside these instructions any information about how you actually carried out the experiment. For example, you should record details of oven, scales, size of plate, thickness of potato slices, and so on. The aim should be that you have enough information for you to recall later in the course exactly how you performed the experiment, or for anyone else to replicate the conditions that you used in your experiment.

SAFETY WARNING

The University has a duty to give advice on safety and first aid to students carrying out any experimental work which is described in the course.

Whenever you do an experiment, you should think about the hazards involved, and how any risks can be minimized. In this experiment, the risks are those that you would face in the kitchen when using sharp knives and when taking hot items out of an oven. You may be a master chef, in which case these precautions may be second nature to you, or you may be a relative novice in the kitchen! But, whatever category of kitchen user you come in, **be careful not to cut yourself when slicing the potatoes, and be careful not to burn yourself when handling the hot plate and potatoes.**

In the unlikely event of a mishap that results in a cut or burn, please refer to the standard first aid information below.

FIRST AID TREATMENTS

Cuts

If you cut yourself badly, try to reduce the blood flow by putting a pad of *clean* tissue or cloth over the wound and pressing gently, but firmly, raising the limb, until the flow stops. Obtain medical aid if necessary.

Burns and scalds

The notes below act as a simple guide for the First Aid treatment of burns and scalds.

- (a) DO NOT prick any blisters;
- (b) DO NOT apply ointments or oil-based dressings.
- (c) DO NOT remove anything sticking to the burn.

If you have any concerns, seek medical aid immediately.

The First Aid treatment of burns and scalds is designed to achieve three basic aims:

1 To get rid of residual heat

The affected area should be immersed in or held under gently running cold water for at least ten minutes, or longer if cessation causes the pain to return. This treatment will relieve the pain and help to reduce the severity of the final injury.

2 To prevent infection

Avoid handling a burn unnecessarily, especially if the skin is broken. Remove any clothing not sticking to the burn and cover the area with a clean, dry dressing. Restrict the movement of badly burned areas.

3 To treat for shock

Patients in shock should be kept warm and as comfortable as possible in a reclining position, with legs raised. Give nothing by mouth and obtain medical aid.

Setting up the experiment

- 1 *Assemble the equipment and materials.* The items that you will require are listed at the beginning of these activity notes, and further details were given in the 'Planning the experiment' section.
- 2 *Prepare the potatoes.* Weigh out about 500 grams (or 1 pound) of potatoes — the amount isn't critical but your weighing should be accurate — and use a sharp knife and a chopping board to cut the potatoes into thin slices, about 1–2 mm thick, if you can manage this. The thinner the slices, the shorter will be the time required to dry the potatoes.

Obtaining the data

- 1 *Weigh the empty plate.* Place the heatproof mat on the scales along with the plate, dish or pan that you are planning to spread the potato slices on, and record their combined mass in the space above Table 3.2.1. (If you are using a *conventional* oven, you may want to cover the plate with crumpled aluminium foil before weighing; this will allow some water to escape from the bottom of the potatoes. *Don't use foil in a microwave oven though.*)
- 2 *Weigh the potatoes on the plate.* Spread the potato slices out on the plate, and weigh the combination of heatproof mat plus plate plus potatoes. Record this mass in the first row of the second column of Table 3.2.1 at time zero.
- 3 *Start drying the potatoes.* Put the plate and potatoes in the oven or airing cupboard.

If you are using a microwave oven:

Set the oven to full power, and the timer to four minutes. After this four-minute heating burst:

- carefully remove plate and potatoes, using an oven glove;
- reweigh the plate and potatoes;
- record the heating time and the mass in the next row of Table 3.2.1 (columns 1 and 2);
- carefully turn and separate the potato slices to help them dry out more quickly;
- put the plate back in the oven;
- heat for another four minutes;
- remove and weigh again;
- record the additional heating time and the mass in the table.

At this stage you should reduce the period for which you heat the potatoes. Your aim is to dry the potatoes without burning them; there is no danger of them burning while the potatoes are still moist and flexible, but as they get harder and browner you should subdivide the four-minute heating periods into shorter bursts of power. We suggest that you split the next heating period into two bursts of two minutes, and turn and separate the slices between the two bursts. You should then reweigh the potatoes after each two-minute burst.

You can then use four bursts of one minute each, and then even shorter bursts, turning and separating the slices between each burst. You should continue making measurements until successive masses recorded in the table differ by under 20 g, or half an ounce.

If you are using a conventional oven:

Set the thermostat of your oven to the lowest setting. This is likely to be 100 °C, or 225 °F, or gas mark 1. Leave the potatoes in the oven for about an hour. Then:

- carefully remove the plate and potatoes using an oven glove;
- reweigh the plate and potatoes;
- record the heating time and the mass in the next row of Table 3.2.1 (columns 1 and 2);
- carefully turn and separate the potato slices to help them dry out more quickly;
- put the plate back in the oven for about another hour;
- remove and weigh again;
- record the additional heating time and the mass in the table.

Repeat the heating, weighing and turning cycle until successive masses recorded in the table differ by less than 20 g, or half an ounce. Note that the time intervals between measurements are not critical, and can be adjusted to fit in with whatever else you are doing.

If you are using an airing cupboard:

Put the potatoes in the warmest area of the cupboard and make sure that air can circulate freely around them. Leave them for about half a day. Then:

- remove the plate and potatoes from the cupboard, and reweigh them;
- record the time in the airing cupboard since the last weighing and the mass in the next row of Table 3.2.1 (columns 1 and 2);
- carefully turn and separate the potato slices to help them dry out more quickly;
- put the plate back in the airing cupboard;
- after about half a day, remove and weigh again;
- record the additional drying time and the mass in the table.

Continue to weigh the plate and potatoes two or three times a day, turning and separating the slices each time, until successive masses recorded in the table differ by less than 20 g, or half an ounce. Note that the time intervals between measurements are not critical.

Having read through the safety warning and the instructions for the experiment, you should now be ready to begin. Go back to the beginning of 'Instructions: practical procedure' and work through them one by one.

Mass of plate (including mat for protecting scales, and foil if used) = 600g *

Table 3.2.1 For recording data from the potato experiment. (You may not need to use all the rows in this table.)

Time in oven since last weighing/Sec.*	Mass of potatoes, plate and mat/grams.*	Mass of potatoes/grams.*	Comments (e.g. appearance of the potatoes, or other observations)
zero	1100	500	Initial mass before heating
240	1000	400	
480	950	350	
720	925	325	
820	900	300	
900	850	250	STARTING TO BROWN
1020	800	200	
1080	800	200	
1200	800	200	
1320	780	180	
1400	780	180	
1500	750	150	DRY / BROWN

*Don't forget to write the unit here! Note that it is neatest to include units in the column headings of tables; then you don't have to give them after each individual reading. The conventional way to do this is to write the heading as 'quantity/unit' e.g. 'Volume/litres' or, in this case, 'Mass of potatoes/g'.

Analysis of results: calculating the percentage of water in the potatoes

You have measured the mass of the potatoes when wet and when dry, but your measurements include the masses of the plate on which you put the potatoes and the heatproof mat. However, you also measured the mass of the plate plus the mat alone — this is the value that you have recorded in the space just above the table.

You can calculate the mass of the potatoes at each stage of the experiment by subtracting the mass of the plate plus the mat from the mass of potatoes, plate and mat. Do this for each of the values in the second column of Table 3.2.1, and enter the results in the third column.

Now enter values for the initial mass of the wet potatoes (at the beginning of the experiment, time zero) and for the mass of the dry potatoes (at the end of the experiment) in the spaces below, and use these values to calculate the mass of water that was in the potatoes initially. Don't forget the units!

initial mass of wet potatoes = 500g
 final mass of dry potatoes = 150g
 mass of water in potatoes = 350g

Now use these masses to calculate the percentage of water that was in the potatoes.

$$\begin{aligned}\% \text{ of water in potatoes} &= \frac{(\text{350g})}{(\text{500g})} \times \frac{100}{100} \\ &= \text{70\%} \text{ (to the nearest whole number)}\end{aligned}$$

If you are unsure about the calculation of the percentage of water, look back at the calculation for cabbage leaves in Section 3.1 of the book (page 32).

Conclusion

The aim of this experiment was to determine the percentage of water in potatoes, and you should have entered a value for this in the appropriate space above. Your experiment can therefore be concluded with a brief statement that summarizes your finding.

Writing a conclusion for the experiment

In the space below, write a one sentence conclusion that summarizes the result of your experiment. Then compare your conclusion with one given in the comments on this activity.

This experiment has shown that the potatoes used for
this experiment contained about 70% water in its mass

Finally, enter the value you obtained for the percentage of water in potatoes in the space provided on page 35 of the book and compare this with your estimated value.



Activity 3.3 Reviewing the potato experiment

(The estimated time for this activity is 25 minutes.)

In the first part of this activity you will watch the DVD-video 'Reviewing the potato experiment' which shows three students in a Study Centre discussing the experiment with their tutor. As you watch, compare your results with theirs, and note particularly the reasons given for the variability of the results.

'Reviewing the potato experiment' is on DVD 1 (DVD videosequence 26–59). You should view this now.

After watching you should answer the following questions.

- If you were to repeat the experiment, would you do anything differently in order to try to improve the result? You should ask yourself whether the equipment, or the method used, could be improved, and if so, what sort of improvements could be made.
- The DVD-video showed that the students and their tutor obtained a range of values for the percentage of water in potatoes. What were the reasons for this variability? Do you think that you would get an identical result if you were to repeat the experiment?

Activity 3.4 Constructing a table of data

In constructing a table of data about the water content of various parts of the human body you will need to consider:

- what title you will give the table;
- how many columns you need and what information each column will contain;
- what headings you will use for the columns;
- in what order you will present the information in the columns.

This will require you to read the paragraph in the book again, and you may find it helpful to highlight the information that you will put in the table. Having decided how you will lay out your table, draw up the appropriate columns and headings, and enter the information from the paragraph.

Activity 3.5 Identifying key points

As you read Section 3.3 pick out — either by highlighting or underlining — those words and phrases that are concerned with particular aspects of camels and cacti, namely *how* (a) cacti and (b) camels *obtain*, *store* and *conserve* water. Be selective and don't be tempted to highlight too many words and phrases. At the end of Section 3.3 you should compare your highlighted/underlined words with the ones in the comments on this activity.

Activity 4.1 Reading to learn: scanning a section

(You should spend no more than 20–30 minutes on this activity.)

Note the advice in the preceding paragraph of the book where you are advised to scan Section 4. To scan the text means to survey it in order to gain an overall impression of what it is about. Read the headings, bold terms, figures and figure captions, and the summary. Look at the rest of the text very quickly, concentrating on the first and last paragraphs in a subsection and pick out key words. Don't try to read every word of the text.

You should read the comments for this activity after scanning Section 4 and noting down the main topics and key ideas.

Activity 4.2 Making notes as you read the text

There are no additional notes for this activity. You should look at the comments when directed to do so after Section 4.1.

Activity 4.3 Annotating text: floating and sinking

(You should spend no more than 10 minutes on the writing part of this activity.)

There are no additional notes for this activity until you have completed Section 4.2.

After you have studied Section 4.2 you should go back and read just your highlighted phrases and notes on why some objects float on water while others sink. Then put your notes away and try to write down an explanation in your own words of why ice floats on water but a block of steel sinks in water. Once you have done this you can go back and look at your notes to check that you have included all the relevant points. You can then revise what you have written if necessary. Putting the notes away while you first write something down ensures that you try to express the explanation in your own words, which is a measure of how well you have understood a topic. Your notes are likely to use the same phrases as the text. (Remember that you first tried doing this in Activity 2.2.)

Activity 4.4 Understanding complex ideas

(You should spend no more than 10 minutes on the writing part of this activity.)

You might have found the preceding paragraph in the book hard to understand. However, if you've met the concept of density before, it might have seemed quite straightforward. But before long you *will* meet a section of text which doesn't immediately make sense. How do you react in this situation?

As you study *Discovering Science* we will be helping you to develop your own strategies for coping when you don't understand what is written. For example, we will be offering further guidance in Box 6.3 of this block. For now, look back at the paragraph that begins 'But how can we tell...' and try to rewrite it in your own words. Even if you think that you understand it, rephrasing the paragraph is a very good test, and you will understand it even better when you have done this. One strategy is to imagine that a friend has asked you 'Why is it that a tree trunk floats on water whereas a steel screw, which is much lighter, sinks?' (see the cartoon on p. 54 of Block 1). How would you explain this?

Activity 4.5 Annotating text: fluids in the body

Here you are looking to identify the fluids in the body *and* the role or roles each plays. You can't assume that the name of each fluid is immediately followed in the text by its role. Therefore, in addition to highlighting appropriate words and phrases, you need a system for identifying which role is linked to which fluid. For example, you may choose to number each fluid and number its role.

After completing your study of Section 4.4.3, turn your highlighted phrases and notes into a list of fluids and their roles, then compare your list with the one in the comments on this activity.

Activity 4.6 Uses of illustrations

(The estimated time for this activity is 15 minutes.)

(a) First of all, let's follow up Box 2.1. Skim back through Figures 4.1 to 4.15 and the cartoon in Section 4.2. Make a note of which of these figures has been included mainly for interest, and which conveys important information.

(b) Now look at Figure 4.16. This figure includes three separate pictures of a male human torso and part of his head. What is the reason for including a diagram such as this to accompany the description of the journey of a glass of water?

(c) Which of the three pictures, (a), (b) or (c), do you think is most useful in clarifying the journey of the glass of water and why? Jot down, also, why you think the other two pictures are less suitable, and suggest what they might be used to illustrate.

(d) Why are only the torso and part of the head shown in Figure 4.16, rather than the whole human body? Why are other internal organs, such as the gall bladder, pancreas and appendix, not labelled, although drawn, on Figure 4.16c? Why is only one kidney shown, instead of two, in Figure 4.16c?

Activity 4.7 Annotating text: changing states of water

This is similar to Activity 4.5, and you may find it helpful to look at the method you used there.

Activity 4.8 Learning from illustrations

There are no additional notes for this activity.

Activity 4.9 Reviewing your study methods

In the introduction to Section 4 you were introduced to a new approach to studying text and to the activity of making notes as you study. As you answer the following questions, compare your study of Section 4 with that of earlier sections.

(a) In Activity 4.1 you tried an approach to study that involved scanning the text before studying it carefully and completing the questions and activities. Think about the benefits of approaching the text this way; what did you gain from this? Did scanning the text give you a broad overview of what you would be studying? Were you able to identify, from your scanning, parts that would be straightforward, or parts that would need extra attention? Do you think that this approach made your study of the text longer or shorter overall? Decide whether you are going to use this approach, of scanning a section before studying it in detail, in subsequent sections.

(b) In Activities 4.2 to 4.5 and 4.7 you practised making notes, rephrasing paragraphs and annotating the text. Did *doing* these things and carrying out the related activities help you understand more clearly what the text was about?

Activity 5.1 Planning your study

(The estimated time for parts (a)–(c) of this activity is 10 minutes.)

The study plan on the bookmark shows that Sections 5–7 should ideally be studied in one week and should take an estimated 10 hours. From the logs of time spent on study that you have kept for earlier sections you should have some indication as to whether you need to set aside more or less than our estimate for studying Sections 5–7. The time needed for studying the second part of Block 1 is considerably longer than the time needed for studying the first part. You need to consider whether the total 'free' time you have available for the week matches your estimated study time.

(a) Based on your experience of studying Sections 2 and 3, estimate the approximate time you think you will need for study of Sections 5–7. For example, if Section 3 took you seven hours (instead of our estimated five and a half hours) then you may need to add about three hours to our estimated 10 hours for Sections 5–7.

Estimated time for studying Sections 5–7 =

(b) Each time period on the grid below is divided into two halves. Use the upper half of the boxes on the grid to draw up a diary for the week by writing down the regular activities in your life. Then write in when you plan to study in the 'free' periods. It may be possible to schedule large blocks of time, for example, study sessions of two hours or a whole morning or evening, but 30-minute sessions are also useful, for studying a maths box, for example. You should also bear in mind your response to Activities 2.1 and 3.1 about whether you found that a particular time of day or length of study period suited you best. Does your estimated study time for this week's work (which you wrote down in part (a)) match the total time you have identified for study? If they don't match, you need to consider how you can adjust your plans. It is important to do this *now* before you start the week's work.

(c) Now indicate on your plan for the week when you hope to complete each of Sections 5 to 7. You will need to refer to the time estimates on the study plan to do this. You should also bear in mind your response to Activity 4.9a about scanning a section before studying it in detail. When planning your work, you might find it helpful to note that there are more of the longer activities in Section 6 than in other sections of this block, including four which will take about 20 minutes each and two which will take around 30 minutes each. Drawing up a study schedule with targets will help you complete the work. This might mean breaking down the work into manageable bits for each study session, for example, deciding on the number of pages you would ideally like to complete at a stretch. However, when beginning a new section or a new block it may be difficult to keep to the schedule and you may need to modify your plan as you progress through the section.

(d) Remember to keep a log of the time you *actually* spend on studying each of Sections 5 to 7, using the lower half of the boxes on the grid.

	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
morning planned							
morning actual							
afternoon planned	11:30 5:30	11:30 5:30					
afternoon actual							
evening planned			7:30 9:30		7:30 9:30	7:30 9:30	
evening actual							

(There are no comments for this activity to read before you have completed Section 5.)

After completing your study of Section 5

Compare your log of study time with your plan and make any necessary adjustments to your plan for Sections 6 and 7. Then read the comments for this activity.

After completing your study of Sections 6.1, 6.3 and the whole of Section 6

Compare your log of study time with your plan. Had you set realistic plans and manageable targets? You might need to make some adjustments to your targets for each study session and your overall plan for Section 7. You may find it helpful to reread the comments for Activity 5.1 at some point during, or at the end of, your study of Section 6.

Activity 5.2 Punctuating text

Without looking back at the original, attempt to make sense of the passage below by breaking it up into sentences, beginning each with a capital letter, and ending each with a full stop. Add capital letters wherever else you think they are appropriate, too. If you have a cooperative friend or relative, ask them to have a go at this same exercise, and then compare your results. You may find that there are some interesting differences.

figure 4.17 shows that some water vapour rises over the oceans and that some is blown inland and moves upwards over land masses, as the air and the water vapour it contains rises it cools down you may have experienced this decrease in temperature when climbing a hill or mountain, if you have ever walked up ben nevis you will know that even in summer there is ice near the summit also at the base of everest there is sub-tropical vegetation, the summit is decidedly less hospitable, as the air becomes colder, some of the water vapour condenses into water droplets which form a cloud, the process is just like the clouds of condensation that form when you exhale warm air from your lungs into a cold atmosphere an effect that is particularly noticeable on cold winter days and nights in a cloud the small droplets join together to make larger droplets and eventually the droplets grow too large to be held in the air any longer and start to fall to earth, you are of course familiar with the end product of this process rain,

Activity 5.3 Sentences and verbs

(a) Examine sentences 1 and 2 below. In each case, identify the verb, or verbs, and state what is the subject of the verb. Where relevant, state what is the object of the verb.

1 Switzerland has heavy snowfall in winter.

2 As the snow thaws, it forms gushing torrents of water.

(b) Read the passage of text below and decide which sentences are complete and which are incomplete, stating why. Rewrite the passage to complete any incomplete sentences.

From a stream the water might be drunk by a cow or join other streams or lakes. The water eventually joining the rivers and returning back to the sea. From here the droplet moves back to the oceans, nature's reservoirs. The cycle continuing indefinitely.

Activity 5.4 Putting commas into sentences

We asked some students to write an account of the same potato experiment that you carried out in Activity 3.2. The passage below is an extract from one student's account. It is broken up into sentences but contains no other form of punctuation. Read the passage carefully and decide where you would place commas in order to make the description easier to follow. Jot down the reasons for your decisions.

In order to carry out the experiment, I used some kitchen scales, a sponge, tin, kitchen foil, a sharp knife, a chopping board, around 500 grams of potatoes, an oven glove and a gas oven. To begin with I cut the potatoes, which were quite large, into thin slices using the knife. Next I placed the slices, making sure that they were lying flat and spread out, so that they were separated on kitchen foil, on top of a metal sponge tin, which had a raised patterned rough base to help evaporate the water given off.

Activity 5.5 Writing concisely: evaporation

Study the sentence below again, carefully, and pencil across the words or phrases that are redundant. Make a note of why you think they are unnecessary.

The process of evaporation, when it occurs, is important because not only does it result in water being evaporated into the air where it may condense into water droplets to form clouds which may lead eventually to rain which will fall onto the land surface, but also because it leads to the water evaporated, if it is evaporated from the oceans, being separated from all the dissolved and solid substances.

Activity 5.6 Writing with a logical flow

In Section 4.4.3 we described the journey of a glass of water through the human body in what we hope was a logical order. The sentences below summarize some of the stages in the journey of a glass of water, but they are no longer ordered logically. Without looking back to the original version, reorganize the list to make the order coherent.

- 1 The water enters the stomach.
- 2 Food not taken up by blood vessels in the small intestine passes with the water into the large intestine.
- 3 In the small intestine, the mixture of water and broken-down food becomes a soft milky suspension.
- 4 Removal of water in the large intestine converts the waste to a semi-solid mixture, which is carried to the rectum and expelled as faeces.
- 5 Within the small intestine the water is mixed with digestive juices which break down food.
- 6 The water enters the mouth.
- 7 Water is propelled from the stomach into the small intestine.

Activity 5.7 The importance of paragraphs

The text at the beginning of Section 5.1 (up to Box 5.1) is divided into five paragraphs which vary in length.

(a) Skim read the five paragraphs, and write down, in a single sentence for each paragraph, what each of them is about.

(b) On the basis of your answer to (a), decide what determines where a new paragraph begins.

Activity 5.8 Turning key points into sentences and paragraphs

Look at our highlighted words about cacti and camels in the comments on Activity 3.5 (reproduced again below for convenience). Imagine that our comments represent the notes you made on this section and included in your Study File.

(a) Without referring to Section 3.3, turn our words and phrases into properly formed sentences that make sense by adding words in the places where there are dots. Don't worry if you have to change some of the words slightly, or their order. Underline the

original highlighted words and phrases that formed part of our comments, for identification.

(b) Suppose that these sentences are to form part of an account of how cacti and camels obtain, store and conserve water in hot deserts. How might you structure them into paragraphs, and why?

Comments on Activity 3.5

cacti ... efficient at storing water in their thick, fleshy stems ... extensive system of shallow roots ... take up water very rapidly ... surface layer is exceptionally waterproof ... leaves are reduced to spines.

camels do not sweat very much ... body temperature can rise by about 2 degrees ... water lost ... comes from throughout the body tissue ... urine ... very concentrated ... faeces ... very dry ... drinking enormous quantities ... water intake from their food ... breaks down fat from its hump ... water is produced.

Activity 6.1 Listing key points

(The total time for stage 2 of this activity is about 20 minutes, divided into a number of chunks.)

We would like you to practise summarizing as you study Section 6, and suggest that you do this in a number of stages.

Stage 1 involves highlighting and annotating the text to identify key points as you study. You have been doing this in earlier sections, though previously you may have only been identifying parts of the text relevant to a specific purpose or question, rather than all of the key points.

Stage 2 involves you pausing at the end of each of Sections 6.1, 6.2, etc., and making a list of the key points from that section. This requires you to look back at your notes and highlighted words and phrases in each sub-section, and to produce a list of the main points. You should aim to identify just five or six points from each main sub-section, and your list need only be in note form at this stage. After making a list for Section 6.1, compare your list with the one in the comments on this activity before studying Section 6.2, and so on.

Stage 3 comes at the end of Section 6 when, in Activity 6.7, you will be asked to produce a summary of the whole section based on your lists of key points for the subsections.

So remember to highlight (or underline) and make notes of the key points as you study Section 6, as this will provide the basis for your summarizing.

There are no comments to read until you have completed Section 6.1.

Activity 6.2 Summarizing text with a diagram

(You should spend no more than 15 minutes on this activity.)

Using Figure 6.7 as an example, construct your own flow diagram to summarize the sources of domestic sewage in surface waters on the land, what happens to the polluted water when it enters the water cycle, and the effects it may have on the water, ourselves and other animal life. This process of producing a flow diagram can make a passage of text easier to follow. (Note that we included pictures in Figure 6.7 to make it more entertaining. We do not expect you to do this.)

Activity 6.3 Using existing knowledge to understand new material

(The estimated time for this activity is 20 minutes.)

Using information from earlier in the block, answer the following questions relating to the *Dune* extract.

- (a) Wearing a stillsuit, a person out in the desert would not expect to lose more than a thimbleful of water (about 2.5×10^{-3} litres) a day, because any water leaving the body is automatically reclaimed by the suit. What is the ratio of this water loss to the water loss of an average person living in the UK (from Table 4.2)?
- (b) List the ways in which water is lost on a daily basis from the human body.
- (c) What do you think is meant by the statement 'Urine and faeces are processed in the thigh pads'?
- (d) When wearing a stillsuit, a person is told to breathe in through the mouth, and out through the nostrils (which are fitted tightly with tubes — probably leading down into the stillsuit). Why do you think it is important for water conservation to breathe out in this way?
- (e) Explain how sweating helps the body to cool down.
- (f) The description mentions that salt is reclaimed, as well as water. Where does this salt come from, and why do you think it's reclaimed?

Activity 6.4 Making notes and using them to write an account

(You should spend no more than 30 minutes on this activity.)

We suggest that you produce your brief account of the camel's ability to survive the shortage of water in a hot desert environment in two stages.

- (a) First, look again at Sections 3.3 and 6.4.1 and make brief notes of relevant points that you will include in your account.
- (b) Then, drawing on your notes for part (a) above, write a brief account about 200 words long, using your own words, of the camel's ability to survive the shortage of water in a hot desert environment.

Your account should be aimed at readers who have not had the benefit of reading the book. This means you will have to explain briefly any processes that you describe. However, your writing style should be concise and you should not try to copy the rather chatty style of the book, which is designed to represent the spoken word rather than a scientific account.

Try to keep as close to 200 words as possible. In the TMAs the number of words is generally specified for guidance as to the length of an appropriate answer and how much detail is expected. You should try to keep to within 10% on either side of the specified number of words, in this case between 180 and 220 words. You may find it easier to begin by writing a draft that is longer than this. You can then check whether you can write more concisely by removing any redundant words and sentences. Alternatively, your draft may be much shorter than the recommended word length, in which case it is important to check that there are no omissions and that you have explained things adequately.

When you have completed your account, compare it with a student's account in the comments on this activity.

Activity 6.5 Writing concisely: how camels survive shortage of water

(You should spend no more than 20 minutes on this activity.)

In Activity 6.4b you wrote a 200-word account of how camels survive the shortage of water in a hot desert environment, and compared it with another student's account in the comments on Activity 6.4b, critically we hope. In this activity you will look at part of an account produced by another student, Nyasha. Her account is very comprehensive, but she ignored our suggested word guidance so her answer is considerably overlength. Read through the extract from her answer carefully and pencil out those words, phrases or sentences that you think are redundant, without losing any of the relevant points. See if you can reduce the account to about half its current length, or even less. You might need to add one or two extra words, to help make sense of passages where you have pencilled out words. You may also have to change some of the punctuation to match. Make a note of why you have chosen to eliminate parts of the answer.

Extracts from Nyasha's answer to Activity 6.4b

Camels that are resident in hot desert regions have evolved in ways that facilitate water retention, thereby avoiding the problems of severe water loss that is usual in such a hot climate. Let's briefly examine how the camel has evolved to do this.

A camel ^{can} is able to withstand a much greater increase in body temperature before becoming over-heated and needing the sweat process to 'cool-off'. ^{camel do} It simply does not need to sweat so much, and therefore reduces loss of water through evaporation of bodily sweat. ^{A Camel} It can also withstand considerable water loss since it can lose up to 40% of its body mass from water loss without harm. ^{Camel} It also passes urine that is very concentrated, ^u which means that the urine contains a lot less water than that, say, of a human being and a lot more of the waste products that are excreted and dissolved in the water. It also has very dry faeces which, ^{is contains} once again, means that they contain a lot less water than the faeces of human beings, for example.

^T In addition to the survival strategies that are described above, the camel has several other features which help it to survive in the desert. These are to do with how the camel drinks and stores water. The camel can drink over 100 litres at one go, which is the same amount of water that would fill about 200 pint sized kitchen measuring jugs. So if it does suffer from a loss of water, it can replenish what it has lost very quickly. (258 words)

Activity 6.6 Communicating science: how camels survive shortage of water



(The estimated time for this activity, including watching the DVD-video, is about 30 minutes.)

Below you will find two copies of another student's answer to Activity 6.4. This one has been prepared by Terry. Read it through, imagining that it forms part of an assignment, and that you are the tutor-counsellor who will be assessing the answer and providing feedback to Terry. The sorts of questions you should be asking yourself about this answer are as follows.

- 1 Are there any incomplete sentences? If so, how would you complete them?
- 2 Are all the sentences the right length to be read comfortably, and do they contain commas to break them up, where appropriate? If not, what changes would you make?
- 3 Is the account written in the most logical manner? If not, how would you restructure it?
- 4 Are there any ambiguities? If so, how might you clarify them?
- 5 Is there anything else that constitutes unclear communication, or are there any factual inaccuracies?

Read Terry's answer carefully, and then attempt to answer each of questions 1–5 in turn, making any changes you think should be made on the first copy of the answer. Doing this activity first will enable you to gain more benefit from the DVD-video.

Terry's answer (first copy)

Water loss is a severe problem for most living creatures in hot arid environments.

The camel being an exception. Camels have evolved such that they can survive with a minimum of water. It is able to survive rises in body temperature of several degrees without ill effect, and it also has long nasal passages which help to cool air leaving the lungs and the body because air is drawn in through them at night when it is cooler so cooling the tubes before it passes to the lungs where it is heated as the lungs are warmer. As the warm air is breathed out it is cleverly cooled by the lower temperature of the nasal passages where some of it condenses and is retained.

There are other helpful strategies. It having the obvious adaptation of the hump. This can store a considerable quantity of water enabling it to go for extended periods without drinking. Its nose is also lined with mucus which 'captures' water leaving the nose from the lungs. (170 words)

In the DVD-video sequence 'Communicating science: how camels survive shortage of water' we eavesdrop on a small group of students at a local centre who have each made their own amendments to the answer. They are discussing with their tutor the different strategies they used to improve Terry's answer, by considering each of the above questions in turn.

As you watch, use the second copy of Terry's answer (*overleaf*) to note down the suggestions that are made by the students at the centre.

After watching the DVD-video compare your two annotated copies of Terry's answer. Then read the comments on this activity.

'Communicating science: how camels survive shortage of water' is on DVD 1 (DVD-video sequence 60-98). You should view this now.

Terry's answer (second copy)

TERRY'S ANSWER

Water loss is a severe problem for most living creatures in hot arid environments. The camel being an exception. Camels have evolved such that they can survive with a minimum of water. ^{They are} It is able to survive rises in body temperature of several degrees without ill effect, and it also has long nasal passages which help to cool air leaving the lungs and the body. ^{This is} because air is drawn in through them at night when it is cooler, so cooling the tubes before it passes to the lungs, where it is heated as the lungs are warmer. As the warm air is breathed out it is cleverly cooled by the lower temperature of the nasal passages where some of it condenses and is retained.

There are other helpful strategies. ^{The camel has} It having the obvious adaptation of the hump. This can store a considerable quantity of water enabling ^{the camel} it to go for extended periods without drinking. Its nose is also lined with mucus which 'captures' water leaving the nose from the lungs.

Activity 6.7 Summarizing a section

(You should spend no more than 20 minutes on this activity.)

You may find it helpful to begin by rereading the notes for Activity 6.1. Write the summary for the whole of Section 6 in concise sentences, rather than notes, and organize it into paragraphs, one paragraph for each subsection. Try to organize the points in each paragraph in a coherent way. When you have completed your summary, compare it with the version that we have prepared.

Activity 7.1 Reviewing your study of Block 1

(You should spend at least 30 minutes on this activity. The time required will depend on how much work you decide to do on those areas of the block that you are unsure about.)

There are three parts to this activity. In the first part you will reflect on planning and finding time for study, while in the second you will review the techniques that you have developed for improving your learning skills. Both of these may provide pointers for your study of Block 2. In the third part you will consider how well you have met the objectives of Block 1, and we suggest ways in which you can improve your performance on the objectives that you have not met.

(a) Planning and finding time for study

For the duration of the course you will need to find at least 12 hours each week for studying, and this means that forward planning and setting targets will be important. You made a start on developing these skills in Activities 2.1, 3.1 and 5.1, and you will find it useful to think about what you have learned from these activities now.

Look back at your original study plan in Activity 5.1 and your log of time spent studying Sections 5, 6 and 7. Think about each of the following questions, and note down your responses.

- As part of Activity 5.1 you set targets for completing each of Sections 5 to 7; how successful were you at meeting your targets?
- Where you did meet or improve on your targets, can you identify what you did that was successful?
- Where you did not meet your targets, think about what caused the problem. Can you identify the reasons? Think about the advice you can give yourself about planning and managing your study of the next block. You may find it useful to use Table 7.1.1.

Table 7.1.1 Reviewing my study of Block 1.

Areas where I did not meet my targets	Reasons	Advice to myself for the next block

Now look at the comments on this part of the activity.

(b) Reviewing learning techniques

We have introduced a number of techniques in the block to help you to study actively, and the main ones are listed below:

- 1 highlighting and annotating text;
- 2 scanning text to get an idea of what lies ahead;
- 3 rephrasing a difficult concept or paragraph in your own words;
- 4 identifying key points;
- 5 summarizing a section in words or a diagram;
- 6 turning a diagram into words.

Spend a few minutes thinking about these techniques, and for each of them try to note down:

- how much you used the technique while studying Block 1;
- whether you found the technique helped you to learn;
- a specific example of when you used the technique and how you decided how to use it, e.g. what to highlight, how you identified key points;
- how you could make better use of the technique in Block 2.

Now look at the comments on this part of the activity.

(c) Meeting the block objectives

Having completed Block 1, you should try to assess how successful your learning has been. A good way to approach this is to check through the list of objectives for the block (see p. 37). This list is divided into objectives that are related to the science content of the block and objectives in four different skills areas — science skills, communicating science skills, mathematics skills, and effective learning skills. These objectives give an overview of what you should know and be able to do after completing your study of the block.

We give more help with both effective learning skills and science skills in the next block, and the DVD-multimedia associated with this block contains self-assessment exercises for you to practise maths skills. So for now we suggest that you think about two groups of objectives: science content (Objectives 1 to 9) and communicating science skills (Objectives 12 to 16).

(i)* Consider Objective 1 first. This is an important objective because it relates to the bold terms introduced in the text. We assume that you can explain the meaning of these terms and use them correctly. Scan through the bold terms in the index at the back of the book, note down the ones you are unsure of, and check the definitions of each of these in the glossary.

(ii) Now try to get an overall picture of where you stand with respect to Objectives 2–9 and 12–16 by quickly reading through the two groups and noting beside each item in the list whether you think that you can meet the objective; you could write in pencil in the margin **Y**(es), **N**(o), or **?** if you are unsure. (You may also find it useful to note whether you think that you could have met the objectives before you studied the block.)

(iii) Now look through the objectives you marked with 'N's, and possibly those you marked with '?'s, and select an objective that you want to concentrate on achieving. You may choose something that you have always found difficult or something that you have met for the first time in this block.

(iv) For the objective that you have selected, go back to the questions and activities associated with that objective, and try them again, without looking back at your original

* Roman numerals are sometimes used as an alternative to the more familiar Arabic system (1, 2, 3, and so on). In the Roman system the following letters are used to represent numbers: I (or i) = 1; V (or v) = 5; X (or x) = 10; L = 50; C = 100; D = 500; M = 1000. (You are only likely to meet i, v and x in S103.) Numbers in between are made up of combinations of letters: using i in front of v or x means 'subtract one'; i following v or x means 'add one'. The first 15 roman numerals are thus: i, ii, iii, iv, v, vi, vii, viii, ix, x, xi, xii, xiii, xiv, xv.

answers. You may need to study sections of the book or appropriate boxes again, and the book index and the contents page will help you to locate the relevant material.

(v) After completing the questions and activities, compare your answers with the answers and comments in the book or the Study File, and with your original answers. You may feel that you have now achieved the objective you were working on, in which case congratulate yourself. But before you move on, pause for a moment's reflection: if the objective required you to understand and learn some science, note down what you did that led to understanding; if the objective required you to practise a skill, tell yourself step-by-step, and note down, how you should tackle such a task in the future.

(vi) You may find that even after slogging away at the questions and activities a second time, and going back to the relevant teaching material, you are still not happy that you can meet a particular objective. If this is the case, can you identify the reason for your difficulty? What can you do if you want to sort it out?

(vii) Now consider whether you should repeat the steps outlined in steps (iii) to (vi) for other objectives that you may have identified as problem areas in step (ii).

What to do now?

There are several further activities for you to carry out before you begin Block 2 and you need to plan when you are going to tackle them. The estimated times given below are to help you in this planning.

You are strongly advised to do *each* of the activities below, so remember to return to this section after completing each activity.

- 1 Complete the practice TMA (TMA 01) and send it to your tutor for him/her to comment on. You will find the TMA in *Assessment Booklet 1*, and you should read the introduction to it now. An ideal time to attempt the TMA is when you have completed Block 1, but if you have trouble with any of the questions you may wish to delay sending it off until you have looked at some of the other materials listed below. (*5 minutes now, 2 hours to complete the TMA.*)
 - 2 Use your computer and DVD 1 (Block 1) to practise and learn maths skills. You should start by working through each activity in the 'Practising maths skills' package to reinforce the maths skills you have developed or revised in Block 1. These are:
 - 'Calculator practice'
 - 'Fractions, decimals, percentages and ratios'
 - 'Units and their representation'
 - 'Powers and scientific notation'There is also material on the skill of 'Handling negative numbers' which is not covered in Block 1 but which will be needed in Block 2. You will therefore find it an advantage to study the two activities: 'Adding and subtracting negative numbers' and 'Multiplying and dividing negative numbers' before you start Block 2. (*'Practising maths skills' 1 $\frac{1}{2}$ hours; 'Handling negative numbers' 45 minutes.*)
 - 3 Use *The Sciences Good Study Guide* to reinforce the skills introduced in Block 1. Page 39 of this Study File provides advice on how you might use the set book before you start Block 2. (*As much time as you choose to spend.*)
-

Comments on activities

These comments should be read after you have attempted the activity for yourself. For most activities there is no one 'correct answer', so we either provide a 'sample answer' to the activity (sometimes produced by a student), or we provide guidance on how you should have tackled the activity and what you might have written in your Study File. We also provide advice about how you might improve particular skills, and this should help you when you tackle similar activities in later blocks or in assignments.

Activity 1.1

(a) You may find that the first place you choose to study is unsuitable. For example, the noise conditions may not suit you. You should therefore be prepared to try studying in different places, to find out what suits you best.

(b) You may also need to modify the way that you organize and store your OU materials as study progresses so that you can find individual items easily.

Many students find the ideal arrangement is to have their computer set up on a large table, situated away from the humdrum of the household, such as in a bedroom. Moving the keyboard, when the computer is not in use, makes space to write. Box files can be kept under the table, on a shelf or on top of a low wardrobe. But finding such an ideal arrangement is not always possible; if the dining table is the only working surface available, you may find that you need to be even more efficient at keeping your materials filed away.

Activity 2.1

To be read after you have completed Section 2.6.

(a) Your log should contain only the time that you spent actively studying, including carrying out the related activities. You may find that you think about the course even when you're not actively engaged in studying. This is part of the process of 'reflection', which will help you to consolidate your learning. But you should not include time spent this way on your log, as it is not part of the notional 15 hours per week that we mentioned in Activity 1.1.

Obviously, the days and times of the day that you are able to study depend on all your other commitments, but many students find it helpful to try to establish a regular pattern during the week. Did you find it easier to study at some times than at others? Some people find they are 'freshest' and most receptive to study in the early morning or early evening, whereas others find they can work best late at night. If you are able to, try to vary the times at which you study Section 3 to see which times suit you best.

If you took longer than our estimate of about $4\frac{1}{2}$ hours for studying the text of Section 2, you may need to plan to spend more than our estimated time for Section 3. Remember this when you do Activity 3.1. It is important that you continue to keep a log of the time spent each week on studying this introductory block, including the days and times of day, as this will help you plan your study of subsequent blocks when you will need to find more hours for study.

(b) The length of a study session depends on a number of factors: the time available, on your concentration span and on the nature of the text you are studying (for

example, whether it is completely new to you). Some students find that they can study without interruption for two hours at a stretch, whereas others find that after 10 minutes they need to have a cup of coffee or stretch their legs. Some students need to sit at a desk to study; others find they can read a book for 5 minutes, for example, while waiting for someone in the car. Also many students think about their course work at odd moments — for example, they might mull over an idea while washing up. You need to find the conditions that suit you best; these may well depend on how tired you feel and the time of day that you study, for example. Try varying the length of study periods for Section 3 to discover the conditions that work best for you.

Of course, you might have found that it was sometimes hard even to begin to study. It is easy to procrastinate: 'I'll start tomorrow!'. You may find it helps to fix a time when you can study, and then to open the book at that time and begin. Once you've started, the rest of the task is relatively easy! We give more help with planning study and finding motivation for study in Activity 2.3.

Activity 2.2

(a) There is no one answer to this activity, of course, but you should have included the following points.

The scientific method is the way that science progresses. Scientists make observations and then search for an explanation, which they call an hypothesis. The next step is to check this explanation by looking for further evidence or by making further measurements or more observations. These might confirm the hypothesis or lead to the scientists rejecting that hypothesis, or enable them to modify the hypothesis. Advances in knowledge and understanding of science are made in this way.

Don't worry if you found you were struggling for words, after all this is the first 'writing' activity in this block! At the end of the Study File (page 42) you will find a glossary of the key terms introduced in Block 1, including all bold terms, such as 'scientific method'. You will find that the Glossary is a useful source of reference when you are unsure of the meaning of an important term but, of course, when asked for 'your own words' you must be sure you don't simply copy out the glossary definition.

(b) The initial observations are of the distribution of the human population and of the distribution of rainfall. The hypothesis is that there are low populations in deserts because rainfall is low in these regions. It is checked by looking for further evidence and the Nile and Indus valleys are found to be exceptions. So the hypothesis is modified to take account of the evidence that a source of water other than rainfall is available.

Activity 2.3

You will have noted that each student in the video had their own individual study pattern built around their work, home and hobbies. You should consider which of their 'ways of working' you could try over the next few weeks and make a note of them; for example, could you use your lunch breaks to scan the text and see what lies ahead as the first student to appear on the sequence did?

The length of time these students studied at a stretch varied according to their concentration span and time available, but it also depended upon the task in hand. For example, the student who is a fireman spent 4 hours on study when he was trying to tackle an assignment but

usually spent 3 hours, punctuated with frequent coffee breaks, when he was studying text.

The students also admitted to the difficulty of finding motivation for study; study competes with many other demands on your time. An important first step is to recognize that this can be a problem. It is also worth noting that their relatives and friends understood that the students needed to be left alone for periods of time, and this is something that you may wish to discuss with the people you live with.

Lastly, but most importantly, the students were not just concerned with finding time for study but with how to use their study time *effectively*. Studying is not just reading the text; it involves thinking about the text, trying to make sense of it and trying to follow the argument. We give help with this throughout the block, starting in Section 3.

Activity 3.1

To be read after you have completed Section 3.4.

(a) When starting a completely new activity such as carrying out some practical work, you need to take time to think ahead, to plan the way that you will do it and to make some preparations. In this case you had to plan when you would do the experiment and how you would carry out the experiment according to the type of oven that you had available. The sort of preparations you had to make included checking that you had all the materials and equipment available at the time that you needed to use them, and that you were free to complete the task over the time period required. Time spent planning and preparing can save time in the long run because it helps you to succeed with your task.

(b) It is important that you continue to monitor your study of Block 1, keeping a note of what worked for you, what went badly and what changes you will make to your study pattern next week. As a beginner, it is worth experimenting with a range of different study patterns to see which suits you best.

(c) If you spent longer on Section 3 than our estimated 5' hours, you may need to adjust our estimated study time of 6 hours for Section 4. Can you identify which components took you longer than our estimate — the text, maths boxes, practical work or DVD-video?

Don't be too concerned if you are taking longer than our estimated times; these are only estimates to be used as a guide. You will find that you will study more efficiently with practice. Remember that it is not just the amount of time you spend on study that is important, it is also how effectively you use this time. The activities that you have carried out this week should have helped you to use your time effectively by aiding your understanding of the text.

Activity 3.2

The following conclusion was reached by one student.

The percentage of water in a sample of potatoes was measured to be 78%.

Don't worry if the value you obtained for the percentage was different. As long as it was between about 70% and 85% you have done well. This variation in measurements is discussed in Activity 3.3.

Activity 3.3

(a) Your response will depend on your own experiences with the potato experiment, but the students on the video had a number of suggestions. Among these were: better time planning so that the experiment could be carried out uninterrupted; better kitchen scales — preferably the electronic scales that one student used; slicing the potatoes more thinly to speed the drying process; making sure that the mass of the potato reached a steady value before completing the measurements.

(b) There are uncertainties attached to almost any measurement, and if you repeated the potato experiment you would be likely to get a different result. The percentage of water in a potato depends on the type of potato and its age, and these are two factors leading to variability in the results of the experiment. In addition, the results depend on how accurately the initial wet mass and the final dry mass of the potatoes are measured. One factor affecting this is the accuracy of the scales you used — different scales can indicate different masses for the same object. Another factor is the uncertainty in reading values of the mass with particular scales — you could probably only measure to the nearest 20 grams (or half an ounce), partly because of your inability to read a precise value for the mass, and partly because scales can indicate a slightly different mass each time you put the same object on them. So if you repeated the experiment you could get a different result because:

- you used different potatoes that contained different percentages of water;
- you used different scales;
- there are small uncertainties associated with reading values for the masses indicated by the scales.

Activity 3.4

Table 3.4.1 is one way to represent the data. It includes a title to explain what the table contains, it includes headings for the columns, and the heading for the column of numbers indicates that these are the water content given as percentages of the mass (of each part of the body). Also, the numbers have been arranged in descending numerical order; this is not essential, and we might have arranged them in ascending order, or even arranged the body parts alphabetically. There are no hard and fast rules for what order is best, but it is usually better to devise some logical order rather than making it random.

Table 3.4.1 The percentage of water in different parts of the human body.

Part of body	Water content/% of total mass
grey matter of brain	84
testes	84
blood	83
muscle	76
most other body tissues	70 to 80
bone	50
tooth enamel	4
hair	3
whole body	65*

* Note that there is no need to give '65%' because the unit '%' is given in the column heading

Activity 3.5

There are no right or wrong answers to this activity, but to give you an idea of what we considered were important key words and phrases on this topic, we highlighted the following (dots indicate omitted words or phrases).

(a) *cacti* ... efficient at storing water in their thick, fleshy stems ... extensive system of shallow roots ... take up water very rapidly ... surface layer is exceptionally waterproof ... leaves are reduced to spines.

(b) *camels* ... do not sweat very much ... body temperature can rise by about 2 degrees ... water lost ... comes from throughout the body tissue ... urine ... very concentrated ... faeces ... very dry ... drinking enormous quantities ... water intake from their food ... breaks down fat from its hump ... water is produced.

Note that the words highlighted are all concerned with *how* camels and cacti *obtain, store* and *conserve* water, as the question required. Hence we did not highlight, for example, the dimensions of a barrel cactus nor the numbers concerned with the amount of loss of body mass and blood volume as these were not appropriate. If you found this technique of identifying important points difficult, don't be worried — it takes practice! We will give more advice on this later.

Activity 4.1

There is no 'right' list of main topics and key ideas but here is the list that we made as we scanned the text. Solid, liquid and gaseous states. Temperature. Ice floating — exceptional. Area, volume, density. Density of an object determines whether it will sink or float on water. Sweating — evaporation cools. Dissolving — water a solvent — harmful substances such as fertilizers. Water from a drink may reach any part of the human body. Water cycle on Earth — continuous.

So condensation builds up as more water vapour meets the can.

Yes! But double glazing helps — must be because window not as cold.

Does thicker fog mean bigger drops or more drops? Ask tutor-counsellor.

Condensation of water on cold objects is evidence for the presence of gaseous water in the air. If you take a can or bottle out of the refrigerator, drops of liquid water — condensation — will appear on its sides. This water must have come from the air. When water vapour in the air comes into contact with a cold surface, it tends to condense as liquid water on that surface. There is an important reason for this occurrence: cold air cannot hold as much water vapour as warm air. The chilled can cools the surrounding air so that it is not capable of holding as much water vapour and the 'rejected' water condenses as a liquid on the cold surface of the can. You will also have observed condensation on the inside of windows when the temperature is cold outside.

Mist, fog, clouds, rain and snow are also consequences of water vapour in the air. All are formed when moist air cools. As the air temperature falls, the air cannot hold all of the water vapour it contains and some of it condenses into very tiny droplets. If these droplets are very small, they remain suspended in the air, either as clouds if at high altitudes, or as mist or fog if near the Earth's surface.

Activity 4.2

How did you annotate the text — highlighting or underlining or something else? Did you use the margin of the book or a separate sheet of paper to write notes?

Your notes are your own personal record, and they will be quite different from those of other students. They need not be intelligible to anyone else, but they do need to be intelligible to you when you look back at them later in the course — so don't make them too brief. We have provided an example in Figure 4.2.1 of the underlined words and the marginal notes that a student made for part of Section 4.1 and this will give you some idea of the sort of thing that this student found helpful. There are more activities to help with note-taking in this and subsequent blocks.

Did you notice that making notes stopped your mind from wandering whilst you studied and helped you to make sense of the words? Another advantage is that you can use your notes and highlighting to remind yourself of the 'story so far' at the start of a study session. Quickly skimming through your annotations to the text should refresh your memory of what you studied in the previous sessions, and get you off to a good start. Try this for yourself at the start of your next study session.

Activity 4.3

Your explanation may look very different from ours. The order of ideas may differ and you may have explained things in a different way. However, your answer should incorporate the following points.

Ice floats on water whereas steel sinks. This is because ice and steel have different densities. Density is mass divided by volume, and materials with a density lower than that of water will float whereas those that have a density higher than that of water will sink.

Now compare your answer with ours. What is important is that you included all the points that we did:

Figure 4.2.1 Example of underlined words and marginal notes for part of Section 4.1 of the book. (Activity 4.2)

- the reason for the behaviour of the solids in water is related to density;
- an explanation of what density is;
- the reason why ice floats and the reason why steel sinks.

Did you omit any of these points? You also need to make sure that what you have written is clear and we give help on this later in Block 1. Note that when you are answering questions like this, it is important to explain the meaning of the concept that you are applying — in this case density.

Writing about complex ideas or novel principles helps you to learn. Learning ideas involves understanding rather than memory and this requires a number of steps. First you need to make sense of the idea; making notes and rephrasing paragraphs (as you also did in Activity 4.4) helps you to make sense of the words. Then you need to think through the idea by relating it both to your existing understanding, and to your own observations, such as, in this case, the behaviour of ice cubes in a drink of fruit juice or a glass of whisky, or plastic toys and bits of soap in a bath. Finally communicating your understanding using your own words, as in this activity or in an assignment to send to your tutor-counsellor, consolidates your learning.

Activity 4.4

One student rephrased the ideas in the passage as follows.

If I put a screw into water the screw will sink, because the steel screw is much heavier (greater mass) than the same volume of water. A big tree trunk would float because the tree weighs less (or has a smaller mass) than the same volume of water.

There are other ways of rephrasing the paragraph — this is just one example. The important thing is to use *your own words* in a way which makes the meaning clear to you. Did you find that rewriting the paragraph, like making notes, helped you to make sense of the words?

Activity 4.5

Your list should include the following:

- saliva — moistens and softens food, starts digestion
- digestive juices — break down food in intestine
- blood — transport medium, carries nutrients and waste (such as carbon dioxide)
- sweat — cools the body and removes some waste salts
- tissue fluid — collects waste materials (such as carbon dioxide)
- urine — removes waste including salts and toxic substances

Note how we have started a new line for each item in the list to make it easier to read. Producing a list like this can be a useful way to summarize a section.

Activity 4.6

(a) All the illustrations, including the unnumbered cartoon, convey important information apart from Figure 4.13, which has been included mainly for interest. Figure

4.1 is a useful reminder of the condensation of water vapour to water droplets, and Figure 4.2 shows a range of temperatures on the Celsius scale. Figures 4.3 to 4.8 demonstrate the various aspects of 'area' being taught. Without these illustrations, it would be difficult to make sense of the concept of area. Similarly, Figures 4.9 to 4.11 demonstrate the concept of volume. Figures 4.12 and 4.14 contain information that is needed to answer questions, and Figure 4.15 illustrates what typical cells look like. The cartoon is a useful reminder that objects with a density higher than that of water sink whereas those with a density lower than water float!

(b) It is much easier to understand the processes that occur as the drink of water progresses through the human body if you have a diagram of some sort to illustrate the various parts of the body involved and their relationship to each other. This is particularly important if your knowledge of the interior of the human body is rather sketchy.

(c) In our opinion, (c) is best. This is a diagrammatic sketch of the relevant internal organs within the human torso. Here all the important organs can be seen, as well as their relationship to each other. In addition, the different colours of the organs make them easier to distinguish from each other. The representation in (a) is realistic — but it offers no help to your understanding of what happens *inside* the body. When accompanying (b) or (c), however, it shows where the internal structures are in relation to the external torso. This sort of illustration is useful for showing external features of the male human torso. Figure (b) is helpful to a limited extent because it shows some of the important organs mentioned in the text. However, because these are drawn realistically, as they would appear in a cut-open body, it is not possible to distinguish clearly some organs from others, such as the small intestine and the large intestine. In addition, important organs such as the bladder and kidneys are hidden from view by the intestines. This sort of figure might be useful as the first step in a guide to dissection.

(d) Only the torso and part of the head are shown because it is only these parts of the body that are relevant to the journey of a glass of water that we describe. Similarly, organs such as the gall bladder, pancreas and appendix are not labelled because they play no direct part in the story. To label them would add unnecessary detail to the figure, leading to possible confusion for the reader. Only one kidney is shown because, at most, only part of a second kidney would show below the overlying organs and because it would clutter the diagram.

Activity 4.7

The points we identified were as follows:

Water *evaporates* from the surface of the ocean. Water vapour *condenses* when the air cools down to form water droplets in clouds and, eventually, rain. Water droplets *freeze* to become hailstones when they fall through temperatures of 0 °C or below. Water vapour in the air *condenses* to become snow when the temperature is 0 °C and below. Hailstones and snow *thaw* to give liquid water.

Note here how we have presented our list as a series of points. You may have started each point on a new line

and we would recommend this because it is clearer, although it takes up much more space. Your annotations of the text should have helped you complete this activity. If they didn't, look back at your annotations and try to work out how your notes could have been improved. For example, did you annotate too much, so you couldn't sort out the relevant points, or did you miss out some relevant points?

Activity 4.8

The following is our perception of what Figure 4.17 is saying.

The Sun evaporates water from the ocean to form water vapour which rises up into the atmosphere and forms clouds, some of which are blown inland. As the clouds rise, the water they contain forms rain or snow which falls on the land below. Some of the water runs off the land into rivers, and eventually back into the ocean, and some percolates deep underground.

Which did you find easier to understand — Figure 4.17 itself or our explanation? Although Figure 4.17 is not a particularly realistic picture of a mountain range and the ocean, it shows the movement within the water cycle very clearly. Most people find that diagrams enhance their study of text because they explain what is going on in a concise and visual way. Similarly *your* written work can sometimes be improved by the use of diagrams. You will be given guidance on drawing diagrams later in the course and you will get your first chance to practise later in this block.

Activity 4.9

(a) Many students find that the initial scan through the text enables them not only to identify the topics being covered but also to see how these topics fit together. Scanning the text also helps to build a framework or an overview of the whole section, into which the details can be slotted the second time you study the section. In other words, this approach aids learning, and probably speeds up overall study of the text.

(b) We hope by now that you have been convinced that *doing* things to the text helps you to think about and make sense of the science involved as well as helping to develop the associated skills.

Activity 5.1

Now that you have reached the end of Section 5, you have probably realized that planning study is not the same as planning production on an industrial assembly line. It is difficult to gauge how long it will take to study a section of text, and it is difficult to predict when work or family commitments may unavoidably force you to change your well-thought-out plans. You therefore need to be flexible and be prepared to update your study plans in the light of the progress you are making and any changes to your other commitments. It is good practice to review your targets and plans a couple of times a week, or when you have completed a major section of the block.

However, it is also important to try to keep up to date week-by-week with the course material because if you fall behind you need to find even more time in order to

catch up. This is why you need to manage your study effectively. Learning to do this whilst you study Block 1 will help you manage your study of later blocks successfully. Managing your study effectively requires:

- planning when you will study;
- setting targets, for example when to complete the study of a section;
- monitoring your progress, for example as you are doing right now in this activity!
- readjusting your plans and resetting your targets in the light of your progress. For example, you may need to find more time in order to complete your study of Sections 6 and 7.

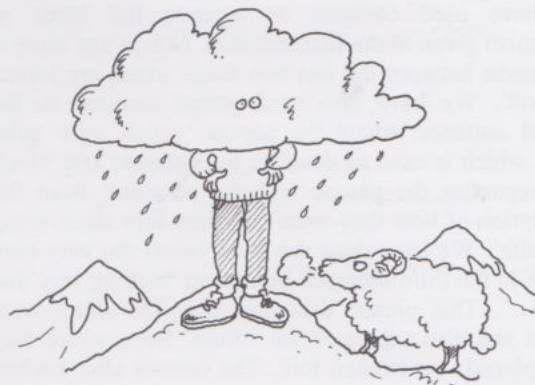
Activity 5.2

The original passage can be found in Section 4.5. You should look at this to see how closely your results compare with the authors' intentions.

It is unlikely that your punctuated paragraph agrees completely with the original. Let's look at a couple of examples to show where differences may have arisen. Look at the original passage and consider the end of the fourth sentence. Suppose you placed the full stop a few words later than in the original passage, after 'Everest'. Mount Everest would no longer illustrate the observation that temperature decreases as you climb higher because ice, rather than sub-tropical vegetation, would occur at its base.

Another problem arises with the seventh and eighth sentences. If you chose to terminate the seventh sentence after the words 'in a cloud', then the meaning of the sentence is different from what the authors intended. The seventh sentence refers back directly to the condensation that forms when you breathe out warm air. You don't have to be in a cloud for this to happen! The eighth sentence refers to a new situation; it is part of the explanation of how rain develops from a cloud of water droplets.

These examples illustrate the sort of ambiguity that can arise when punctuation is absent or incorrect — the passage can take on a completely different meaning. So to get your message across, you need to make sure that you use the correct punctuation.



Activity 5.3

(a) 1 There is only one verb in this sentence, *has*. The subject of 'has' is *Switzerland* and its object is *snowfall*.

2 In this sentence there are two verbs, *thaws* and *forms*. The subject of 'thaws' is *snow* and the subject of 'forms' is *it*, which refers to the thawed snow of the first part of the sentence. 'Thaws' has no object, because none is needed; the object of 'forms' is *torrents*. The phrase 'of water' describes the torrents; 'water' is not the object of the verb.

(b) There are two incomplete sentences, the second and the fourth. In these sentences the only verbs present end in '-ing' (the present participle). The simplest way to make them complete is to use 'joins' instead of 'joining', 'returns' instead of 'returning' and 'continues' instead of 'continuing'. Alternatively, you could make the second (incomplete) sentence part of the first, and the fourth (incomplete) sentence part of the third, as follows.

From a stream the water might be drunk by a cow or join other streams or lakes, the water eventually joining the rivers and returning back to the sea. From here the droplet moves back to the oceans, nature's reservoirs, the cycle continuing indefinitely.

You may wonder why we are discussing sentence construction. S103 is a *science* course. Does it really matter? A quick look back at the passages of text given in the notes for Activities 5.2 and 5.3 should convince you of the importance of punctuation and the dangers of incomplete sentences. If the writing is not clear the science may be misunderstood.

Activity 5.4

We have inserted commas where we think they should go.

In order to carry out the experiment I used some kitchen scales, a sponge tin, kitchen foil, a sharp knife, a chopping board, around 500 grams of potatoes, an oven glove and a gas oven. To begin with I cut the potatoes, which were quite large, into thin slices using the knife. Next I placed the slices, making sure that they were lying flat and spread out so that they were separated, on kitchen foil, on top of a metal sponge tin which had a raised, patterned, rough base to help evaporate the water given off.

Do you agree with the position of the commas?

We have used commas to separate the items of equipment given in the first sentence. Notice that there is no comma between the last two items which are joined by 'and'. We have also used paired commas in the second sentence, round the phrase 'which were quite large' which is used to describe the potatoes and which also separates the phrase 'cut the potatoes' from the description of how they were cut, 'into thin slices using the knife'. We have done the same round the very long phrase in the third sentence beginning 'making sure that they ...'. This phrase describes how the slices were placed and also separates the 'slices' from where they were placed, 'on kitchen foil'. The comma after kitchen foil separates the two stages of the operation, namely, 'on kitchen foil' and 'on top of a metal sponge tin'. Finally, we have put commas in between the list of adjectives, 'raised', 'patterned' and 'rough', that are used to describe the base of the sponge tin.

In addition, you might have put a comma after 'base', near the end of the last sentence, to separate the description of the sponge tin from the activity of separating the slices in order to help evaporation.

This was quite a difficult activity, so don't worry if you omitted one or two commas. Do check, however, that you understand why we inserted them.

Activity 5.5

We have underlined the words and phrases that we think are redundant in the sentence below. The circled numbers (e.g. ③) refer to our explanations of why the preceding words and phrases are redundant.

You may have come up with a different amended sentence; there is more than one way of shortening a sentence.

The process of evaporation, when it occurs ①, is important because not only does it result in ② water being ② evaporated into the air where it ② may condense into water droplets ③ to form clouds which may lead eventually to rain which will fall onto the land surface ④, but also because it leads to the water evaporated, if it is ⑤ evaporated from the oceans, being separated from all the dissolved and solid substances.

① The preceding phrase, 'process of evaporation' implies that evaporation is occurring, so this is unnecessary repetition.

② The two phrases are repetitious and state the obvious. Where else does the evaporated water go, if not into the air? We have retained the really important point, that the water condenses to form clouds. Removal of the two phrases makes the word 'being' redundant; the sentence reads more easily without it.

③ The condensation of water vapour (evaporated water) implies that water droplets form, so there is no need to state this.

④ Again, this is stating the obvious as rain goes down, not up. (A lot of rain falls over the oceans, too.)

⑤ 'Evaporated' does not need to be repeated. (In fact, the whole of 'the water evaporated, if it is evaporated from the oceans' could have been summed up in just two words 'evaporated seawater'.)

Our amended sentence now reads as follows:

The process of evaporation is important because water evaporated may condense to form clouds which may eventually lead to rain, and also because it leads to the water evaporated from the oceans being separated from all the dissolved and solid substances.

Note that, to make sense of this sentence, we have had to change the word 'but' after 'rain' to 'and'.

This is still a very long sentence. We would have to change other words completely (see, e.g., note 5 above) if we wanted to make it still more concise, and yet retain the two main points: that evaporation leads to water being cycled, and also to the separation of water from dissolved and solid substances. Check that your own amended version retains these two main points.

Activity 5.6

The most logical reordering follows the natural progression of the water from its initial intake through the mouth, to the ultimate expulsion of some of it from the rectum.

- 6 The water enters the mouth.
- 1 The water enters the stomach.
- 7 Water is propelled from the stomach into the small intestine.
- 5 Within the small intestine the water is mixed with digestive juices which break down food.
- 3 In the small intestine, the mixture of water and broken-down food becomes a soft milky suspension.
- 2 Food not taken up by blood vessels in the small intestine passes with the water into the large intestine.
- 4 Removal of water in the large intestine converts the waste to a semi-solid mixture, which is carried to the rectum and expelled as faeces.

Thinking about the logical order in which you will present a series of points or ideas is an essential step in producing a piece of writing. You will get a lot of practice in doing this during the course.

Activity 5.7

(a) The first paragraph is introducing the reader to thinking about writing. The second is about communicating in note form. The third deals with communicating more formally, such as by letter. The fourth covers writing assignment answers. The last one draws attention to the need to consider the purpose of each piece of writing.

(b) In each case a new paragraph begins where there is a change of topic.

Activity 5.8

(a) There is no set way of converting the words and phrases into sentences. An attempt by a student is given below. The words underlined are those highlighted in our comments on Activity 3.5. In this attempt the order of the words has not been changed. You may have decided to change this order in which case your attempt might read quite differently.

Student's attempt

Cacti are efficient at storing water in their thick, fleshy stems. They also have an extensive system of shallow roots which take up water very rapidly, so little can run away. The surface layer is exceptionally waterproof, so water is not easily lost and leaves are reduced to spines.

Camels do not sweat very much and their body temperature can rise by about 2 degrees before they start to sweat. When they do sweat the water lost comes from throughout the body tissue. Their urine is very concentrated and their faeces are very dry. Also they can drink enormous quantities at a time, in addition to the water intake from their food. A camel breaks down fat from its hump when starved, and water is produced in this process.

Notice how similar these paragraphs are to the original text because the activity required you to link highlighted or underlined phrases in the text, rather than to write the answer in your own words.

(b) As a new paragraph signals a change of subject matter, it is appropriate to have two paragraphs. The first contains the sentences about cacti and the second comments on camels. You may have structured your answer to (a) like this, intuitively.

Activity 6.1

The key points we have noted from each section are listed below. As you finish each sub-section, check your notes with ours to make sure you haven't missed anything out.

Key points of Section 6.1

71% Earth's surface is oceans — about 96% of Earth's water is in oceans.

Seawater contains salts — kidneys require water to remove excess salt — even thirstier.

Fresh water from seawater — desalination.

Smallest particle of water — a molecule.

Powers of ten — positive powers for large numbers (e.g. 10^6 is a million), negative for small numbers (e.g. 10^{-6} is a millionth).

Scientific notation — less than 10 and greater or equal to 1 along with power of 10 (e.g. 1.46×10^3).

Key points of Section 6.2

13% annual precipitation is exploited.

Water required by humans for survival depends on temperature, activity. Use depends on availability: 136 litres per person per day in UK; 10 litres in developing countries.

World-wide: domestic use 8%; developed — more for industry, developing — more for agriculture.

Key points of Section 6.3

Pollution — industrial (lead, mercury), domestic (sewage), agricultural (fertilizers, herbicides and pesticides).

Metals, herbicides, pesticides build to toxic levels in plants, animals — health problems for humans.

Sewage — source of cholera, typhoid. Depletes dissolved oxygen — aquatic animals die.

Fertilizers — excessive plant growth — oxygen depletion — prevents oxygen dissolving — again aquatic animals die.

Raw sewage — bacterial break down uses oxygen; excessive sewage — oxygen depletion as observed in Thames — oxygen levels varied over historical time.

Water that contains as much dissolved oxygen as it can — saturated.

Key points of Section 6.4

Camels — reduced water loss from sweating and exhaled air.

Cacti — spines in place of leaves, stomata on stems open at night, water loss minimal.

Stillsuit fictional desert clothing — retains and recycles body water.

Activity 6.2

Our attempt at a diagram is shown in Figure 6.2.1. This is just one possibility and yours is probably drawn differently. Compare yours with ours and note the differences. Have you noted all the key points and the links between them?

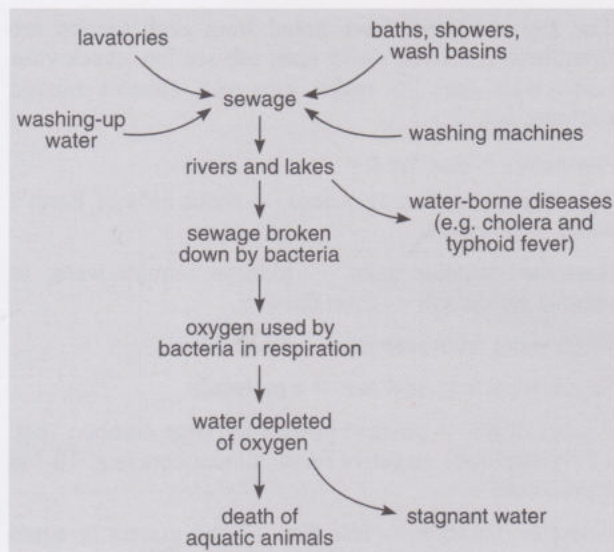


Figure 6.2.1 The sources of sewage in surface waters on the land, what happens to the polluted water when it enters the water cycle and its effects on the water, humans and other animal life.

Figure 6.2.2 shows two more examples that were drawn by students who attempted this activity. Which of the three do *you* think is the better summary? Has each student included *all* the sources of sewage and considered *all* the effects of polluted water on humans and other animal life?

This way of summarizing a piece of text by using a flow diagram contrasts with the way of summarizing text by making a list of key points, as you are doing for Activity 6.1. (Remember that you also did this in Activities 4.5 and 4.7.) It is worth trying a range of ways of summarizing so that when you make your own notes in later blocks you can lay them out in the way that suits you best. One advantage of setting out your notes as a

flow diagram is that it not only gives the main points but it also shows their relationship to each other.

In Activity 4.8 we discussed the way in which diagrams can enhance your written work. Even if no one else sees them, drawing your own diagrams can also help you to understand the text. This is because in drawing a diagram you have to think about the text more carefully (in the same way as when you are highlighting, writing notes or summarizing). Also, drawing a diagram makes you think about the links between concepts. As your study skills develop you might find it helpful to write notes in a diagrammatic form for certain pieces of text, particularly where a number of inter-related processes are involved. We will give you help with this in later blocks.

Activity 6.3

(a) From Table 4.2 you learned that the average person takes in 2.5 litres a day, and loses 2.5 litres each day. The ratio of water lost by a stillsuit wearer to water lost by an average person in the UK in a day is therefore 2.5×10^{-3} litres : 2.5 litres, or 2.5×10^{-3} : 2.5, or 10^{-3} : 1, or 1 : 1 000. Note that we first divided both sides of the ratio by litres, then by 2.5, and then multiplied both sides by 1 000. Multiplying or dividing both sides of a ratio by the same number or the same units leaves the ratio unchanged.

(b) Water is lost through the excretion of urine and faeces, by sweating and in the air we breathe out from our lungs (see Table 4.2 and the description in Section 4.4.3).

(c) Water is extracted from the urine and faeces (and treated so that it is fit for human consumption again).

(d) The breathing arrangement is important because it helps to prevent loss of water. Water is lost from the body by evaporation from the surface of the inside of the lungs, forming water vapour in the air that is breathed out (Sections 4.4.3 and 6.4.1). By breathing out through the nose, the air passes into the tubes fitted to the nose where the water vapour will condense, and can then be recycled. Although you are not told this in the description, you can infer it from what you know about water in exhaled breath.

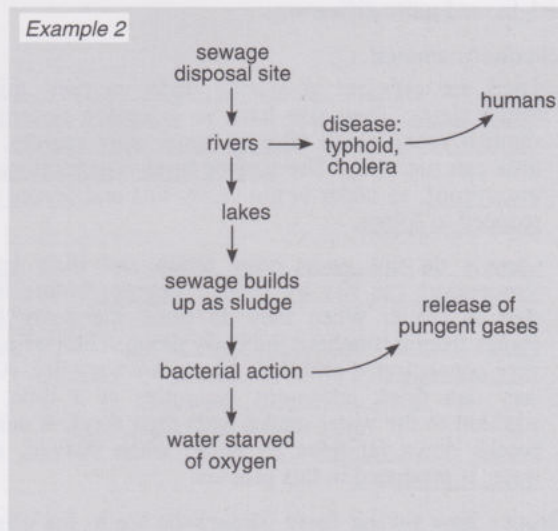
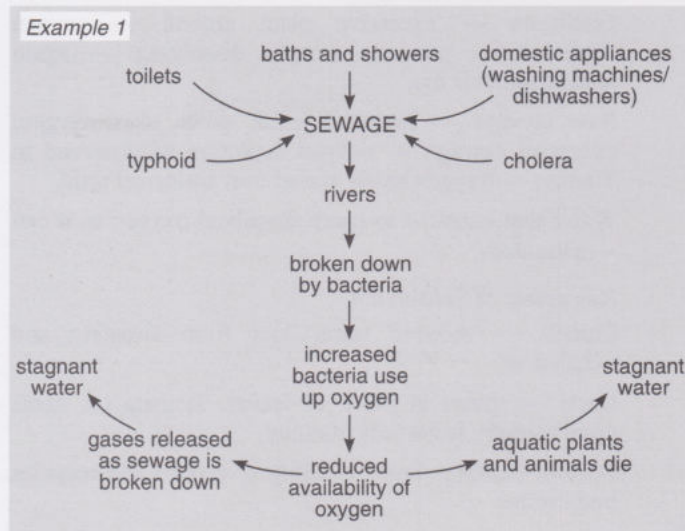


Figure 6.2.2 Two examples of flow diagrams constructed by students to summarize the sources of sewage in surface waters on the land, what happens to the polluted water when it enters the water cycle, and its effect on the water, humans and other animal life.

(e) It is the evaporation of the perspiration that produces the cooling effect (Section 4.3). The body supplies energy (as heat) to evaporate the perspiration and, as the body loses this energy to the water, it cools down.

(f) Some of the reclaimed salt will come from sweat, but most of it will come from the urine, which contains salts that have been filtered out of the blood by the kidneys (Section 4.4.3). The salt is reclaimed in order to remove it from the urine and sweat so that the purified water can be recycled for drinking.

This activity demonstrates that knowledge acquired in one context (water in the human body) can be used to understand a quite different situation (Fremen in stillsuits on Arrakis). As your scientific knowledge increases, you will frequently find that you can use it to make sense of all kinds of new situations.

Activity 6.4

(a) As we asked you specifically to make *notes*, full sentences aren't needed. Our suggested notes are given below.

Sweating: not much, body temperature can rise about 2 °C before sweating and rises more than 3 °C without harm. Water lost comes from body tissue not just blood. Can survive loss of water equal to 40% of body mass.

Breathing: long narrow nasal passages between nose and tube down to lungs. Cold night air cools passages, inhaled air warmed by lungs, exhaled air cooled by passages, water condenses. Retention aided by water-absorbing mucus.

Urine: more concentrated (less than 50% water for given quantity of waste compared to humans).

Faeces: very dry.

Water intake: can drink large quantities at a time, water released from fat in hump.

(b) The account below was written by a student, using the notes in part (a) and you should compare your answer with this one. The order in which you have presented the points may well be different, but this doesn't matter as long as your account is coherent and the science is correct. Check whether there are any points in this account that you omitted from your answer. Check also to see whether you have included any relevant points that were omitted from the account below. Finally, think about how easy it was to produce an answer of the required length, which included all of the relevant points.

Student's account

Camels have developed three main strategies to survive the shortage of water in the desert.

The first is that they reduce their need for sweating, which occurs to cool the body down, by allowing the body temperature to rise above normal before they begin to sweat. The camel may lose as much as 40% of its body mass from water loss (from body tissue rather than just blood) and still survive.

A camel's urine is more concentrated than that of humans and contains less than half as much water for a given quantity of waste material. Furthermore its faeces are much drier. Camels can drink over 100 litres at a time to make up for the water they have lost

and also, if a camel has to break down fat from its hump, water is produced in the process.

Finally, a camel has long, narrow nasal passages which help to conserve water at night when the temperature is lower than in the day. When air warmed by the lungs is exhaled it is cooled by the lower temperature in the nasal passages and water vapour condenses. Also the nasal passages are lined with mucus which absorbs water. (197 words)

Note that although this student mentions *three* main strategies to survive the shortage of water, six strategies are actually discussed: reduced need for sweating; can withstand water loss (reduced body mass); concentrated urine and drier faeces; vast intake of water by drinking; release of water through breakdown of fat; and factors relating to the camel's nasal passages.

The two-step approach that we suggested for this activity is one that you will find useful when answering questions in an assignment. First, you should identify the relevant pieces of text, read them carefully and make notes, which might be done in the form of a diagram similar to the one you produced for Activity 6.2. Second, *using your own words*, you should turn your notes into a coherent piece of writing. You may need to check parts of the text again at this stage to make certain of the accuracy of your writing, and you will need to do some rewriting in order to improve the clarity and coherence of your answer.

You will also need to check the length of your answer, since assignment questions usually specify a recommended length. You should aim for your answer to be within about 10% of a recommended length, though if a question says 'no more than 200 words' you should make sure that you don't exceed this length.

Activity 6.5

Our attempt at making Nyasha's answer more concise is given below. We have underlined the words we would delete, and have used square brackets [] round any words we have added to make sure the remaining text is intelligible. The circled numbers (e.g. ③) refer to our explanations, given after the annotated account.

Camels that are resident in hot desert regions have evolved in ways that facilitate water retention, thereby avoiding the problems of severe water loss that is usual in such a hot climate.① Let's briefly examine how the camel has evolved to do this.②

A camel is able to withstand a much greater increase in body temperature before becoming over-heated and needing the sweat process to 'cool off'. It simply does not need to sweat so much, and therefore reduces loss of water through evaporation of bodily sweat.③ It can also withstand considerable water loss since it can lose up to 40% of its body mass from water loss ③ without harm.

It also passes urine that is very concentrated, which means that the urine contains③ [containing] a lot less water than that, say, of a human being and a lot more of the waste products that are excreted and dissolved in the water.③ It also has very dry faeces which, once again, means that they contain a lot less water than the faeces of human beings, for example.③

In addition to the[se] survival strategies that are described above, the camel has several other features that help it to survive in the desert.① These are to do

with how the camel drinks and stores water.③ The camel can drink over 100 litres at one go, which is the same amount of water that would fill about 200 pint sized kitchen measuring jugs.④ So if it does suffer from a loss of water,③ it can replenish what it has lost very quickly. (259 words)

Comments

① This is not necessary because it is simply repeating the first part of the sentence using different words.

② This is an example of where Nyasha has written in a chatty style that is not appropriate for a scientific account. What she says adds 'colour' to her writing, but not much in the way of relevant information. When there is a word limit you cannot afford to do this.

③ These are examples of repetition or redundancy.

④ Bearing in mind that our advice was to write for a reader who had not had the benefit of reading this book, Nyasha has tried to be helpful here by giving an illustration of how much water 100 litres represents. However, she would have been safe to assume that most people will know that the average kitchen measuring jug holds about half a litre and a medium-sized saucepan holds a litre, so 100 litres is a large volume of water.

So that you can see what our shortened version of Nyasha's answer looks like more clearly, we have printed it below, without all the underlinings and brackets. As you can see, it is now down to 121 words.

Shortened version of Nyasha's answer

Camels that are resident in hot desert regions have evolved in ways that facilitate water retention. A camel is able to withstand a much greater increase in body temperature before becoming over-heated and needing the sweat process to 'cool off'. It can also withstand considerable water loss since it can lose up to 40% of its body mass without harm. It also passes urine that is very concentrated, containing a lot less water than that of a human being and a lot more of the waste products. It also has very dry faeces.

In addition to these survival strategies, the camel can drink up to 100 litres at one go, so it can replenish what it has lost very quickly. (121 words)

A shortened version of Nyasha's answer, produced by another student, is given below. If you compare our amended version of Nyasha's answer with that of the student you will see that there are some differences. Nevertheless, both versions retain the main points that Nyasha makes, but in far fewer words.

Another student's answer to Activity 6.5

Camels in hot desert regions have evolved ways that facilitate water retention, avoiding problems of severe water loss. These include a camel's ability to withstand both a much greater increase in body temperature before becoming over-heated and needing to sweat, and a reduced body mass due to water loss. Urine is very concentrated containing a lot less water than that of a human being and a lot more of the waste products dissolved in the water. It also has very dry faeces, again containing a lot less water than the faeces of human beings.

In addition the camel has several other features which help it to survive in the desert. The camel can drink

over 100 litres at one go, so it can replenish what it has lost very quickly. (131 words)

Activity 6.6

The main points you should have picked up from Terry's answer and the DVD-video are as follows. On the DVD-video the students and tutor suggest ways of amending each of the errors but these are not given below.

- 1 There are two incomplete sentences, for example, the second sentence in the first paragraph.
- 2 The sentence in the first paragraph that begins 'It is able to survive rises in body temperature ...' is too long to be read comfortably. It needs splitting into several shorter sentences, and to be broken up with commas.
- 3 The account could have been written in a more logical fashion, for example, by considering all adaptations that relate to the camel's nasal passages together.
- 4 There are various places where what Terry means isn't quite what he has written, and so his writing is somewhat ambiguous. For example, in the sentence 'As the warm air is breathed out it is cleverly cooled by the lower temperature of the nasal passages where some of it condenses and is retained.'. Terry doesn't make it clear that it is the *water* that condenses and is retained.
- 5 Terry has misunderstood the function of the camel's hump. It is factually inaccurate to say that it stores *water*. The hump stores fat, which releases water when it is broken down. In addition, he has not explained the importance of the camel's body temperature being able to rise without ill effect.

In order to obtain high marks for answers to questions in assignments, you will not only have to show that you understand the science, but you will also have to write clearly, without ambiguities, coherently and concisely.

Activity 6.7

Our overall summary of Section 6 is given below. We have identified a large number of key points for Section 6 because it is a long section and covers a wide range of topics. Compare your summary with ours. It doesn't matter if you have included more points than we have, but it is important that you haven't missed any major points. Also you may have included the skills that have been developed, whereas we listed these in the book after this activity.

Summary of Section 6

Over 70% of the Earth's surface is covered by water, and all but a few per cent is in the oceans. Seawater contains salts, and since the kidneys require water to remove excess salts from our bodies, drinking seawater makes one even thirstier. Fresh water can be obtained from seawater by the process of desalination. The smallest particle of water that is still recognizably water is called a molecule.

Only about 13% of the annual global precipitation is exploited for domestic, industrial and agricultural needs. The amount of water required by humans for survival depends upon the temperature and how active a person is. Use of water depends on how readily available it is.

World-wide, in developed countries industry accounts for most water usage whereas in developing countries most water is used on agriculture; domestic use is 8%.

Pollution of waterways comes from three main sources: industrial waste, agricultural waste and domestic waste. Metals and some herbicides and pesticides may build up to toxic levels in the tissues of aquatic plants and animals and cause health problems for humans who eat them. Fertilizers washed into rivers and lakes lead to excessive plant growth which causes oxygen depletion by preventing oxygen from dissolving in the water and hence lead to the death of aquatic animals. Sewage is a source of water-borne diseases such as cholera and typhoid, and can also lead to the rapid depletion of dissolved oxygen in water and again to the deaths of aquatic animals. Levels of oxygen depletion in the Thames have varied over historical time. Water that contains as much dissolved oxygen as it can possibly hold is said to be saturated, or fully oxygenated.

Desert organisms are adapted to life without a ready supply of water. Camels minimize water loss from sweating and exhaled air. Desert cacti have spines without stomata (pores) in place of leaves and the stomata that they do have on their stems only open at night when water loss through them is minimal. The stillsuit is a fictional item of desert clothing designed to retain and recycle body water so that humans can live in 'desert' environments.

Producing a summary of a section like this is a useful exercise because it forces you to consider what the important points are. We normally provide summaries at the end of each major section in the S103 books, but will sometimes ask you to produce your own summaries. At other times you may wish to produce your own summary before reading the one in the book.

Activity 7.1

The notes that you have made in response to parts (a) and (b) of the activity should be useful when you start studying Block 2, so make sure that you file them for future reference.

(a) If you met or improved on the targets you set you can congratulate yourself. However, it's much more likely that you didn't meet some of the targets that you set, and hopefully you have identified some reasons for this. It might be because your targets were unrealistic, or perhaps you were not using your study time effectively; for example, you may not have been studying actively, just reading the text and letting your mind wander. It may be that you take longer than average on particular types of study material — perhaps mathematical material, or material that involves a lot of diagrams, or producing written answers. Your response may have been along the lines of:

The maths, I'm finding it really difficult.

It took me much longer than the Study File said to do the writing activities.

I haven't really settled down yet, but I will when the course begins properly.

Awareness of how you cope with different materials can help you to plan how much time you'll need for studying later blocks and enable you to set realistic

targets. It is also useful to know if there is material that you can study more quickly than average, as you will then be able to plan to devote less time to that sort of material, leaving more time for areas that you find difficult.

If you couldn't devote as much time as you anticipated to studying, you may wish to think about whether there are ways that you can 'reserve' time for studying in the months ahead. Bear in mind the need to find about 10 hours for studying the course materials each week, plus at least a couple of hours for assessment, reflection and consolidation of what you are learning.

Of course, targets may be missed for a variety of reasons besides shortcomings in your planning or underestimates of study time required. There are all kinds of unexpected events that can mess up the best-laid plans — everything from crises at work or illness, to the pet rabbit escaping or the car failing its MoT test. Many of these you can do nothing about; you just have to be prepared to be flexible and modify your plans in response to events. But there will be some 'distractions' from study that you may have to discipline yourself to say 'no' to, such as watching TV, or you may have to cut down on housework, and the more disciplined you are about reserving time for study, the more successful you are likely to be.

One other word of advice: if you can get ahead with your studies, then it will be much easier to cope with the unexpected events than if you are up against the deadline for submitting an assignment. So why not make a resolution now that you won't leave everything until the last minute!

The sort of advice you might have given yourself to help meet future targets may have been along the following lines:

I should allow more time for the mathematical materials.

I should not dwell too long on areas where I am stuck.

I will try to be quicker at deciding what to highlight.

(b) Your responses to the questions about study techniques will be very much your own, and different from those of other students. What is important is that you have started to think about how you can learn more effectively as you work through the course, starting with Block 2.

A typical student response on highlighting might be:

I used highlighting in most of the block. To begin with I seemed to highlight almost everything, but then I realized that wasn't helping me to pick out anything important. The trouble was it all seemed important to me, and I didn't know what to miss out, so it wasn't helping me to learn.

Then I did Activity 3.5, where I only had to highlight things about cacti and camels obtaining, storing and conserving water, and I found that if I stuck to just that, I could cut down a lot.

I think what I'll do in the future is first think about what it is I need to know out of a section, and then go back over it a second time with my highlighter and just mark that. That just leaves me with the problem of how I work out what I need to know.

The study techniques introduced in Block 1 have been found helpful by many science students (including the authors of this block!). They require practice to get the most benefit out of them and you will be using them again in Block 2. You may find some of the techniques more useful than others. The important point to remember is that you will study more effectively if you play a more active part than simply reading the text. For example, note-taking and summarizing involve you interacting with the text, and this helps you to learn.

(c) Identifying what you can do well and what you need to do more work on are important parts of learning. Both are helped by the strategy of checking the objectives to see what you need to know and choosing to do more work on any you feel unsure about. This ensures that you have worked on whatever you need to before you move on to the next block.

When reading the objectives, you may have been surprised at how much you have already achieved in completing your study of Block 1. However, you probably found some objectives that you were unsure about, and we hope that this didn't make you too despondent. Very few S103 students will achieve every single objective, and you will sometimes have difficult decisions to make about which objectives to devote more time to.

If you are unable to achieve one of the objectives, even after going back through the book, and the relevant questions and activities, then one of the following options may be the way ahead.

- If the objective doesn't seem very important, then you could forget about it, and move on to other more important parts of the course.
- If the objective relates to a communication skill, you may find additional help in *The Sciences Good Study Guide*. The list of objectives contains marginal references to SGSG which you can follow up if you have difficulties with any of the skills. Note that in the list of objectives we also give references to SGSG under two other skills headings, namely maths and effective learning skills. These references relate to the activity 'What to do now?', which you should move on to after you have completed Activity 7.1.
- Your tutor can help you to sort out any difficulties.
- Other S103 students in your study group may be able to help. That it is why it is important for you to try to attend as many tutorials at Study Centres as possible.

Don't forget there are further tasks to do before you start Block 2. Details are given in 'What to do now?' on page 24.

Objectives for Block 1

The objectives state what you should understand and what you should be able to do after studying the block.

The numbers of questions and activities that test each objective are given in italics. In the margin next to some objectives are references to *The Sciences Good Study Guide* (SGSG),* giving the chapter: section number or Maths Help (MH) number, or to the Block 1 DVD material, where you can find additional support.

Science content

- 1 Explain the meaning of, and use correctly, all of the terms printed in **bold** in the text.
- 2 Outline why water is essential for life and what roles it plays in the human body. (*Question 4.9; Activity 4.5*)
- 3 Explain what is meant by an overall balance between the amount of water taken into the body and the amount of water lost from the body (*Question 4.9*), how sweating cools the body, and how excess salts are removed from the body. (*Activities 4.5 and 6.3*)
- 4 Outline how camels and cacti are adapted to live in hot, dry deserts. (*Activities 3.5, 5.8, 6.4–6.6*)
- 5 Describe the three states of water, with reference to:
 - the permanency of their shape, and the space they occupy (*Question 4.1*)
 - the processes of melting, freezing, boiling, evaporation and condensation that lead to changes of the state. (*Question 4.7; Activity 4.7*)
- 6 Calculate the density of an object from its mass and volume, and use the concept of density to explain why some objects float in a liquid and others sink. (*Question 4.6; Activities 4.3 and 4.4*)
- 7 Outline how the Celsius temperature scale is defined, and understand the meaning of negative temperatures on this scale. (*Questions 4.2 and 4.3*)
- 8 Describe where water is stored on Earth, outline the water cycle, and identify the places in this cycle where changes of state occur. (*Activities 4.7 and 4.8*)
- 9 Outline the consequences for living organisms of human activities that interact with the water cycle. (*Questions 6.10 and 7.6; Activity 6.2*)

Science skills

- 10 Illustrate the stages of the scientific method by describing how they match the steps scientists go through in a particular investigation. (*Activity 2.2*)
- 11 Carry out an experiment by following a set of instructions, including planning the experiment, making and recording measurements, using the measurements to calculate a desired result, reaching a conclusion, and reviewing the experiment and suggesting ways in which it might be improved. (*Activities 3.1–3.3*)

Communicating science skills

- 12 Read information from tables, and construct a table (with title, columns and rows of information, and column headings with appropriate units) from information provided. (*Questions 2.2, 2.6, 2.7, 2.11, 2.12, 4.8 and 6.1; Activity 3.4*) SGSG 5: 5 — last 7 pages
- 13 Read information from graphs. (*Questions 3.7–3.9 and 6.10*) SGSG 3: 3.2; MH10 — first 5 pages
- 14 Read information from diagrams, draw diagrams, and recognize that different types of diagrams serve different purposes. (*Activities 4.6, 4.8 and 6.2*) SGSG 3: 2.1, 3.2 — first 3 pages

*Northedge, A., Thomas, J., Lane, A. and Peasgood, A. (1997) *The Sciences Good Study Guide*, The Open University.

- SGSG 9: 3 15 Write in complete sentences, using capital letters for the beginning of a word where appropriate, and using full stops and commas for punctuation, and use paragraphs appropriately. (*Question 5.1; Activities 5.2–5.4, 5.7 and 6.4*)
- SGSG 9: 3 16 Write a brief (100–200 word) account of a scientific topic in a clear, concise and coherent manner, and criticize the lack of these qualities in the writing of others. (*Activities 5.5, 5.6, 5.8, 6.4–6.7*)

Mathematical skills

- Block 1 DVD 'Practising maths skills'; SGSG 5: 3.3; MH1 17 Use a calculator for addition, subtraction, multiplication and division of both whole numbers and decimal numbers, and where an equation has more than one operation, carry out these in the correct order. (*Questions 2.3–2.7, 3.3, 3.5, 4.4 and 4.6*)
- Block 1 DVD 'Practising maths skills'; SGSG MH3, MH5 18 Use fractions, ratios and percentages to express the relationship between two numbers. (*Questions 2.8–2.13, 3.9, 4.8, 6.1, 6.9 and 6.10; Activities 3.2 and 6.3*)
- Block 1 DVD 'Practising maths skills'; SGSG 5: 4.1, 4.2, 4.4 19 State the SI units of mass, length, time, area, volume and density, and their prefixes, and use them correctly in calculations and when quoting values of measured quantities. (*Questions 3.1, 3.2, 3.7, 3.8, 4.4–4.6, 6.8 and 7.5*)
- Block 1 DVD 'Practising maths skills'; SGSG MH4, MH6 — first 2 pages 20 Use decimal numbers in calculations, convert between fractions and decimals, and express a decimal to a specified number of decimal places by rounding. (*Questions 3.3–3.6, 3.9, 4.6, 4.8, 6.1 and 6.9*)
- Block 1 DVD 'Practising maths skills'; SGSG 5: 3.1, 4.2; MH8 21 Express numbers using powers of 10, and using scientific notation. (*Questions 6.2–6.8*)
- SGSG MH7 — first 3 pages 22 Use powers for units and for numbers other than 10. (*Questions 4.4–4.6 and 7.1–7.5*)

Effective learning skills

- SGSG 1: 3 23 Plan where to study, keep a log of time spent on study, plan a week's work and plan a study session, and review each of these. (*Activities 1.1, 2.1, 2.3, 3.1, 5.1 and 7.1*)
- SGSG 2: 3, 5.1 24 Use a variety of techniques to study text, including: referring to the summaries; highlighting; making notes; rephrasing a difficult concept or paragraph; scanning text; identifying key points and using these to produce a summary; using objectives; and reviewing each of these. (*Activities 2.2, 3.5, 4.1–4.5, 4.7, 4.9, 6.1, 6.4, 6.7 and 7.1*)
- SGSG 2: 2.2 25 Use a dictionary, educated guesses, your tutor or other students to help you to make sense of text containing some unfamiliar and unexplained words. (*Activity 6.3*)

Using *The Sciences Good Study Guide*

The Sciences Good Study Guide (SGSG) is designed to help you to think more deeply about and to practise many of the skills used in maths, science and technology. This book will be used alongside the course blocks all through the year. You will be referred to specific sections when doing certain activities but you will also be encouraged to get into the habit of referring to the book when you decide that you want more advice about, or practice with, a specific skills area.

There are several ways in which you might use this book before you start Block 2 and these are given below. Look through the list and decide for yourself what your priorities should be. Don't attempt to read SGSG from end to end; scan through to see what it contains, and select something specific you want to work on, and concentrate on that.

1 If you have not looked at the book at all, we suggest that you become familiar with its style and layout by looking at:

- Chapter 1, Sections 1 to 3;
- Chapter 2, Section 1;
- Chapter 3, Sections 1 and 2 (up to Section 2.1);
- Chapter 4, Section 1;
- Chapter 6, Section 1;
- Chapter 7, Section 1;
- Chapter 8, Sections 1 and 2.

(If you registered early for S103 you may have received advice from your Regional Centre on preparing for S103 which included these SGSG references.)

2 If you identified in Activity 7.1 any objectives relating to *communicating science skills* that you still feel uncertain about, you may find it helpful to follow up the SGSG references given in the margin beside the objectives.

3 Finally, you could choose to use SGSG more generally in order to reinforce the skills which were introduced in Block 1 and which will be developed in Block 2. The suggestions below overlap with the specific references in the list of objectives. You should scan through the list below and decide which might be the most important topics for you.

- Chapter 1, Sections 3.1 and 3.3 on *managing time and practical arrangements for study* will probably help you as you reflect on your experiences with Block 1, and plan how to settle down to the demands of the course. If you are really concerned about planning your time and making the most of it, then Chapter 1, Section 2, should provide additional help. Are your problems like those of Mark and Sushma, who are introduced there?
- In Block 1 you were *reading and making notes*, and you could study Chapter 2, Sections 2.1, 2.2, 3 and 5.1 (up to 'Notes and bookmarks'), if you feel you want to reinforce your skills in this area.
- Chapter 3, Sections 2.1 and 3.2, would help you to review the *purpose of diagrams* and thus further prepare you for Blocks 2 and 3, where diagrams are used extensively.
- If, having worked through the Block 1 DVD material on practising maths skills, you want more help with *specific maths techniques*, Chapter 4, Section 3 and Chapter 5, Sections 3 (to the end of 3.1), 4 and 5, could be useful. SGSG also contains extra guidance and practice in the Maths Help sections which are referred to in the list of objectives. (Note that SGSG Maths Help 1 introduces the mnemonic BIDMAS for the sequence of operations in a calculation, whereas in Book 1 we have used BODMAS. The 'I' in BIDMAS stands for 'indices', an alternative term for powers, and if you are doing a calculation that involves indices then you will need to work these out before you do the 'DMAS' operations. You may prefer to use this alternative mnemonic.)
- You might also like to scan Chapter 7, Sections 3 and 4, after you have set up your computer and worked through the Block 1 DVD activities.

S103 Course Team

S103 *Discovering Science* was produced for the Science Faculty by a team drawn from many areas of the Open University. The full list of contributors to the course is printed in the S103 *Course Guide*.

Block 1 was produced for the S103 Course Team by the team of people listed below.

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Glossary for Block 1

Glossary entry headings that are followed by an asterisk (*) are terms that we expect you to be able to explain the meaning of, and use correctly, both during your study of the course and at the end of the course. We do not necessarily expect you to remember definitions of the other terms; they are included here for convenience. Cross-references within entries to other Glossary entries are indicated by underlining.

analogy An object or system that has similar features to an otherwise different object or system of interest, such that it can be used to help explain or understand particular features of the object or system of interest.

area* A measure of the size of the surface of an object. The areas of squares and rectangles are found by multiplying their length by their width. In SI units, area is measured in square metres (m^2).

axis (of a graph) A horizontal or vertical reference line which carries a scale, used to locate points on a graph. Graphs have both horizontal and vertical axes.

BODMAS* A mnemonic that tells you the order in which you must carry out the operations in calculations. Brackets have precedence over all other operations (i.e. complete any operations inside brackets first), followed by the Divisions and Multiplications, and finally the Additions and Subtractions. However, in any part of a calculation that involves just divisions and multiplications, or just additions and subtractions, you must work from left to right, i.e. in the order in which the calculation is written. *SGSG* uses the mnemonic BIDMAS, where 'I' stands for 'indices', an alternative term for 'powers'. When doing a calculation involving indices, you need to work these out before doing the 'DMAS' operations.

boiling temperature* The temperature at which a liquid boils, i.e. bubbles up and turns into a gas. This temperature depends on various factors, and the normal boiling temperature is the temperature at which the liquid boils at sea-level under normal atmospheric conditions. (These conditions are defined in Block 2.) On the Celsius scale the normal boiling temperature of water is 100°C .

Celsius scale* A scale used for measuring temperature. The normal freezing temperature of water on this scale is defined as 0°C (zero degrees Celsius) and the normal boiling temperature of water as 100°C (one hundred degrees Celsius).

centi* A prefix to a unit, which means 'one-hundredth'; for example, a centimetre is one-hundredth of a metre, $1\text{ cm} = \frac{1}{100}\text{ m}$.

condensation* The process whereby a substance changes from the gaseous state to the liquid state, e.g. water changes from water vapour to liquid water.

decimal number* A number that includes a fraction expressed by digits to the right of a whole number (or zero) and separated from it by a decimal point, for example 12.345. In this example, 12 is a whole number,

the 3 denotes three-tenths ($3/10$), the 4 denotes four-hundredths ($4/100$), and the 5 denotes five-thousandths ($5/1000$).

decimal places* The number of digits after the decimal point in a decimal number. For example, the number 12.345 is expressed to three decimal places.

decimal point* This separates the whole number and the fractional part of a decimal number and is represented by a full stop. In the number 12.34, the digits to the left of the decimal point represent a whole number, 12, and the digits to the right of the decimal point each represent a fraction — the 3 denotes $3/10$ and the 4 denotes $4/100$.

degree (temperature) A unit for measurement of temperature, denoted by the symbol ($^\circ$). On the Celsius scale temperatures are measured in degrees Celsius, $^\circ\text{C}$. There are 100°C between the normal freezing temperature and the normal boiling temperature of water.

density* The mass of a substance per unit volume, i.e. $\text{density} = \frac{\text{mass}}{\text{volume}}$. In SI units the unit of density is kg/m^3 , that is kg m^{-3} .

dissolve* When a substance, such as salt, is put in a liquid, such as water, it separates into very small particles, which become dispersed in the water so that they can no longer be seen. The salt is said to dissolve in the water to give a solution of salt in water. Some solids do not dissolve in water, but do dissolve in other liquids. Gases can also dissolve in liquids.

equation* A means of showing that two (mathematical) expressions are equal to each other. An equation such as $24 + 42 = 66$ has two sides, which are separated by an equals sign ($=$), and which are exactly equal to each other.

equivalent fraction* Any fraction can be expressed as a variety of equivalent fractions, each of which has an equal value. For example, $\frac{1}{3}$ equals $\frac{2}{6}$ (both the top and the bottom have been multiplied by 2), which equals $\frac{4}{12}$ (both top and bottom have been multiplied by 2), so $\frac{1}{3}$, $\frac{2}{6}$, $\frac{4}{12}$ are equivalent fractions.

estimate An approximate value of a quantity, which is not based on precise measurements or exact calculations. For example, you might estimate the height of a person to be about 1.7 m, or you might estimate the area of a room measuring $4.23\text{ m} \times 2.92\text{ m}$ to be $(4 \times 3)\text{ m}^2$, or 12 m^2 .

evaporation* The process whereby a substance changes from the liquid state to the gaseous state, e.g. liquid water evaporates to form water vapour. The conversion of a liquid into a gas is also often called vaporization.

flow diagram A means of summarizing a number of points, ideas or processes, each of which is linked to others by arrows that show the logical sequence.

fraction* A quantity that is part of a whole. For example $\frac{3}{8}$, which can also be written as $3/8$, represents three of the eight equal parts into which an object can notionally be divided. The term also includes 'top heavy' fractions, such as $3/2$ and $8/3$, which are greater than one.

freezing temperature* The temperature at which a liquid freezes, i.e. turns to solid on cooling. This temperature depends on various factors, and the *normal* freezing temperature is the temperature at which the liquid freezes at sea-level under normal atmospheric conditions. (These conditions are defined in Block 2.) On the Celsius scale the normal freezing temperature of water is 0°C .

gas* One of the three states in which substances can exist; the other two are solid and liquid. An example of a gas is water vapour — the gaseous state of water.

graph* A means of illustrating the relationship between two variable quantities (such as mass and time) by plotting the value of one measured quantity using a scale along a horizontal axis and the value of the other using a scale along a vertical axis.

horizontal axis See axis.

hypothesis* A tentative explanation, based on the available evidence, which accounts for observations or facts. It may be tested by making further observations, and may be modified in the light of new evidence or observations.

insoluble* A substance that does not dissolve in a liquid is said to be insoluble in that liquid.

interpolation* The process of reading between points plotted on a graph, in order to find the value of one or both of the plotted quantities at intermediate positions.

key (in map or diagram) A list of colours, symbols, abbreviations etc. used in a map or diagram, together with their meanings.

kilo* A prefix to a unit, which means 'one thousand'; for example, 1 kilogram, abbreviated to 1 kg, is 1 000 grams.

kilogram* In SI units, the unit of mass, abbreviated to kg.

liquid* One of the three states in which substances can exist; the other two are solid and gas.

litre* A unit of volume equal to the volume of a cube that has 10 cm sides. Hence 1 litre = $1\,000\text{ cm}^3$ and 1 000 litres = 1 m^3 . Abbreviated to l (but beware of confusing the letter l with the number 1).

mass* The quantity of matter in an object. In SI units, the unit of mass is the kilogram.

metre* In SI units, the unit of length, abbreviated to m.

milli* A prefix to a unit, which means 'one-thousandth'; for example, one millimetre is one-thousandth of a metre, $1\text{ mm} = \frac{1}{1000}\text{ m}$.

origin (of a graph) The point on a graph where both the horizontal scale and the vertical scale are zero.

percentage* A way of expressing a fraction represented as hundredths. So twelve per cent, or 12%, is the same as twelve-hundredths, or $\frac{12}{100}$. To convert any fraction into a percentage you multiply it by 100%. Expressing values as percentages enables them to be easily compared.

population density A measure of the number of people (or organisms) living within a certain area. In a city there are a large number of people living in an area of 1 km^2 , so the population density is high. In a desert the population density is low.

power (in mathematics)* A superscript after a number or unit. A positive power indicates how many times that number or unit must be multiplied by itself; for example, $2^3 = 2 \times 2 \times 2$, where the power is 3. A negative power indicates how many times you must divide by the number or unit; for example, $\text{m}^{-2} = \frac{1}{\text{m} \times \text{m}}$ where the power is -2.

powers of ten* A notation for representing a number as a larger or a smaller number multiplied by a power of ten. For example, in powers of ten notation, 1 234 can be written as 1.234×10^3 or 12.34×10^2 or 0.1234×10^4 or $123\,400 \times 10^{-2}$. When the decimal number is between 1 and 10, for example, 1.234×10^3 , then this is also known as scientific notation.

precipitation* A collective term that includes all the forms in which water from the air falls on the Earth's surface (as rain, snow, sleet or hail, and also as frost and dew).

proportion The size, number or amount of one object or group as compared to the size, number or amount of another. A proportion can be expressed as a fraction, ratio or percentage.

qualitative (information) Information or data that do not involve numbers, for example, colour, smell or taste, are said to be qualitative. See also quantitative.

quantitative (information) Measurements or data with numbers and units attached to them, for example the number of centimetres of rain per year, are said to be quantitative. See also qualitative.

ratio* The relationship between the sizes of two similar quantities. For example, if there are 3 men and 8 women in a group, then the ratio of men to women is 3 to 8, and this ratio can be written as 3 : 8. Ratios do not have units attached to them.

rounding* Approximating a number by reducing the number of digits (usually to the right of the decimal point). Rounding follows a convention: if the last digit to remain is followed by a digit between 0 and 4 then it is

left unchanged, but if the last digit to remain is followed by a digit between 5 and 9 then it is increased by one.

saturation* The condition in which as much of a substance as possible is held within another substance, usually a liquid. For example, when the maximum amount of a salt (or gas) is dissolved in water, the salt (or gas) level is at saturation, and the solution is said to be saturated.

scale A set of divisions used for measurements, as on a ruler. Scales are used on the axes of a graph to allow data to be plotted at points corresponding to specific values. For example, each centimetre of the scale on the axis may represent one year, or it may represent 10 °C.

scale bar A line on a diagram that indicates the size of the object illustrated. For example, a one centimetre line on a diagram may represent a kilometre, showing that the object has been reduced in size, or a millimetre, in which case the object has been increased in size.

scientific method* The way in which advances in our knowledge and understanding of science are often made. Scientists produce a hypothesis to explain certain facts or observations. They test this hypothesis by making further observations or measurements. These results might confirm the hypothesis, or might lead scientists to modify the hypothesis, or to replace the hypothesis by a completely new hypothesis.

scientific notation* A notation that represents any number by expressing it as a number between 1 and 10 multiplied by a power of ten. Thus 1.30×10^3 is in scientific notation (because 1.3 is between 1 and 10), but 0.130×10^4 and 13.0×10^2 are not. *See also* powers of ten.

scientific theory* A well-established explanation that is consistent with a wide range of observations and has been tested where possible by experiments.

second* In SI units, the unit of time, abbreviated to s.

SI units* An abbreviation for the Système Internationale d'Unités (International System of Units). SI units are used by scientists all over the world to make measurements according to agreed standards. Examples of SI units are the kilogram for mass, the metre for length, and the second for time.

solid* One of the three states in which substances can exist; the other two are liquid and gas.

soluble* A substance that will dissolve in a liquid is said to be soluble in that liquid.

solution* A solution is formed when one substance dissolves in another. For example, salt dissolves in water to produce a solution of salt in water. *See* dissolve.

solvent* A liquid that will dissolve another substance.

states* Substances can exist in three different states: solid, liquid and gas.

stomata The small openings in the surface of a leaf or stem through which water vapour and other gases pass in and out.

superscript* A number (or letter) written above the line and in a smaller type, as in the case of 2 in m². *See also* power (in mathematics).

sweating The process whereby fluid (water and dissolved salts) is excreted in the form of drops through pores in the skin. Energy is supplied by the body to evaporate the sweat, and hence the skin cools down.

trend The general direction taken, for example, by a series of measurements.

unit A quantity that is used as a standard of measurement. For example, a metre and a centimetre are units of length, and a litre is a unit of volume.

vaporization* *See* evaporation.

vertical axis *See* axis.

volume* A measure of the size of the three-dimensional space that a solid, liquid or gas occupies. The volume of a rectangular block or cube is found by multiplying the length by the width by the height. In SI units, volume is measured in cubic metres (m³).

water cycle* The continuous circulation of water on Earth between ocean, atmosphere, land, biological organisms, etc. It involves water changing its state between solid (ice), liquid (water), and gas (water vapour).

water vapour* The gaseous state of water, which forms when water evaporates.

weight* The downward pull on an object due to gravity. Weight decreases on the Moon where gravity exerts a weaker pull on an object than on Earth. The term weight is often used colloquially in contexts where the correct scientific term is mass.

word equation An equation that is expressed in words rather than in numbers or symbols, for example, density = $\frac{\text{mass}}{\text{volume}}$.